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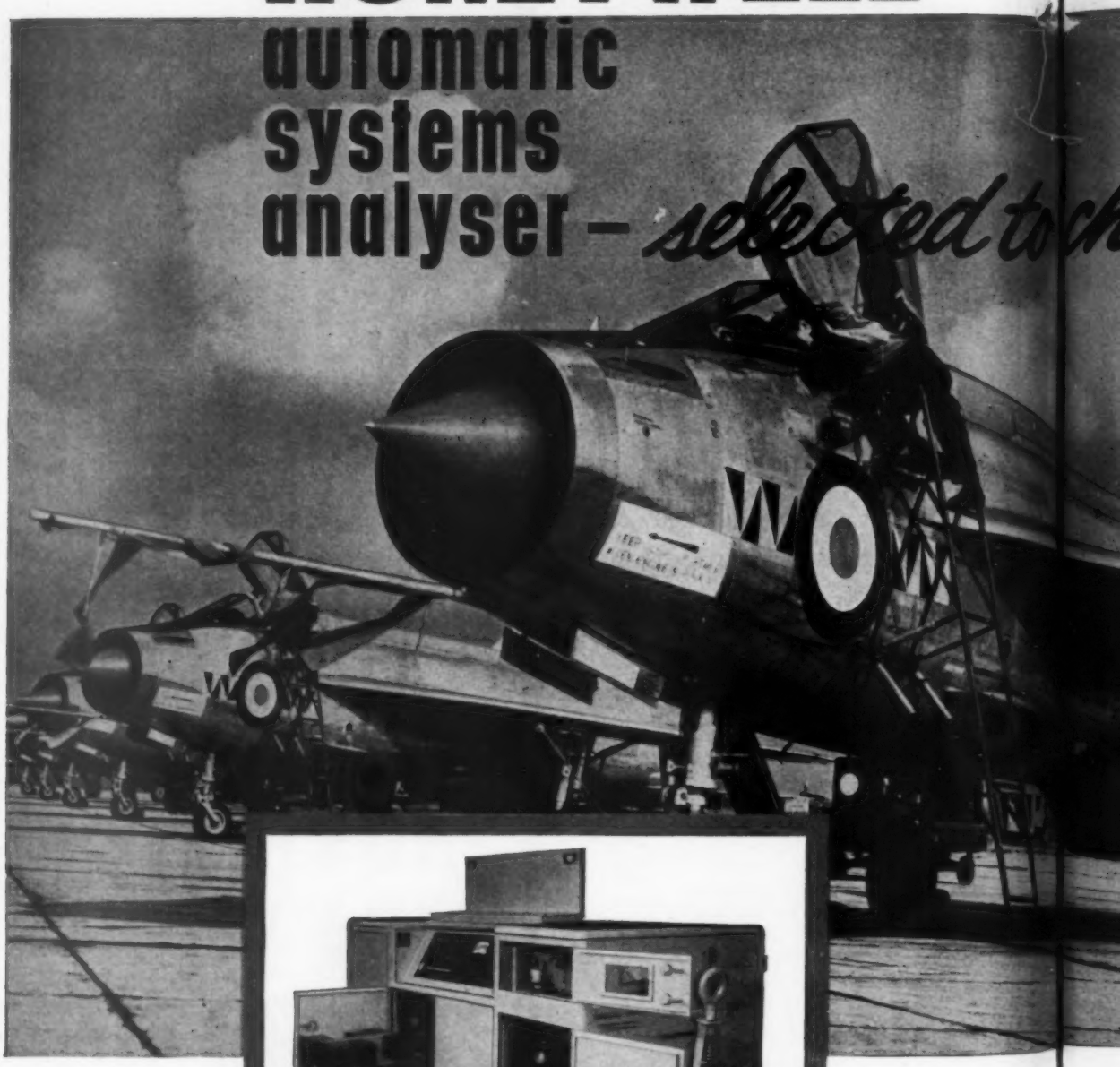

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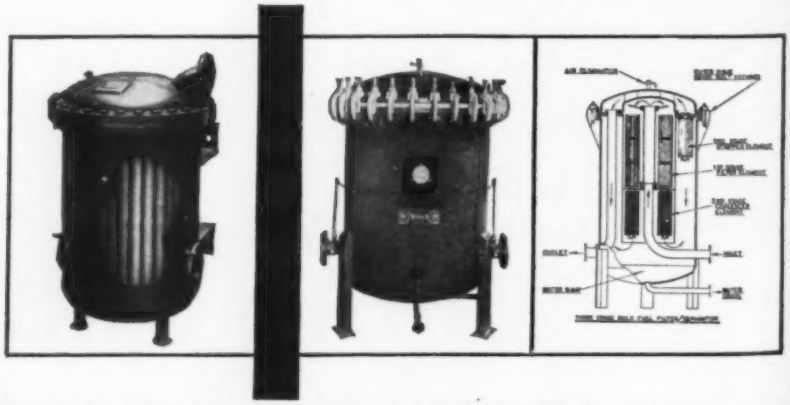

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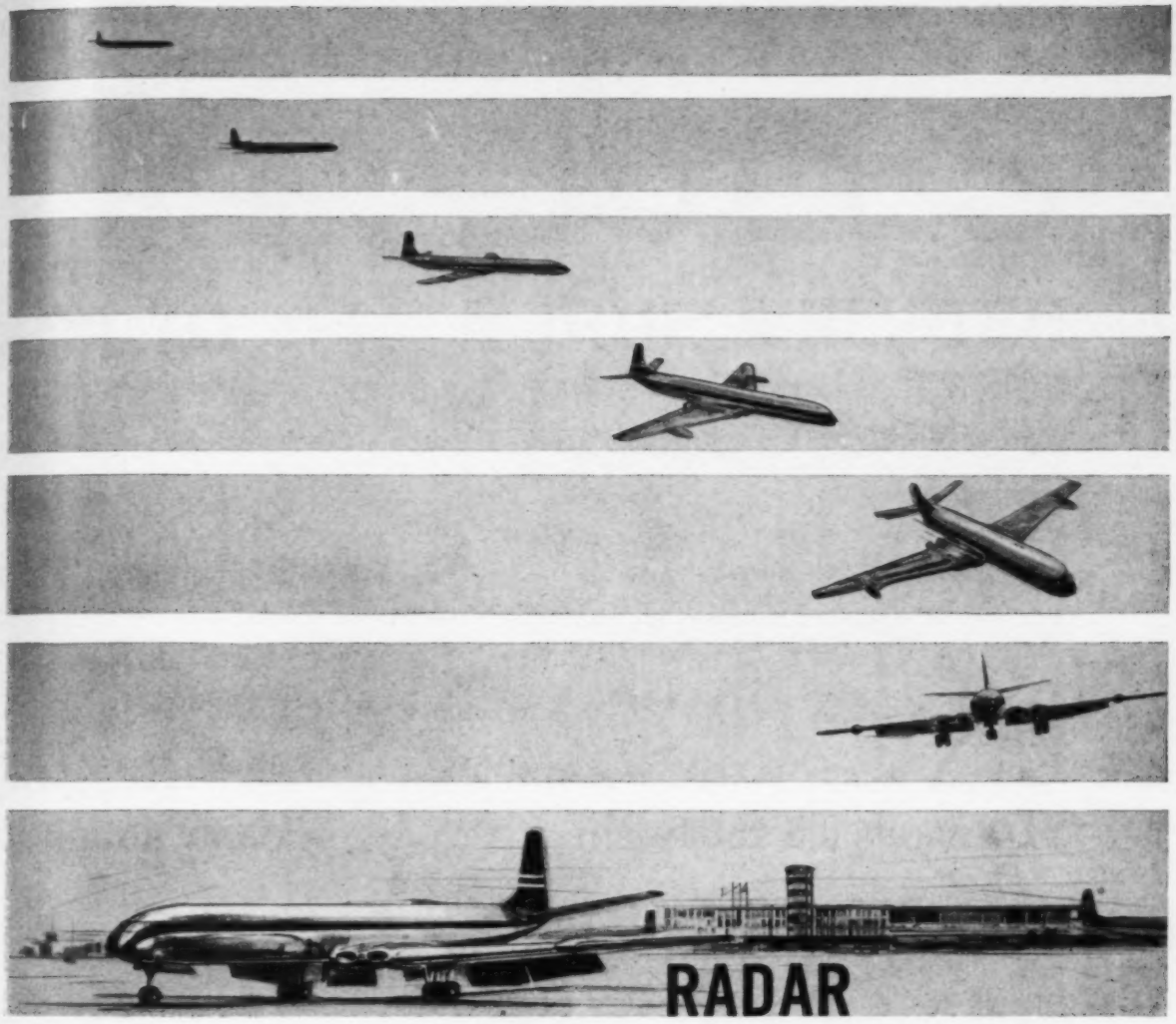

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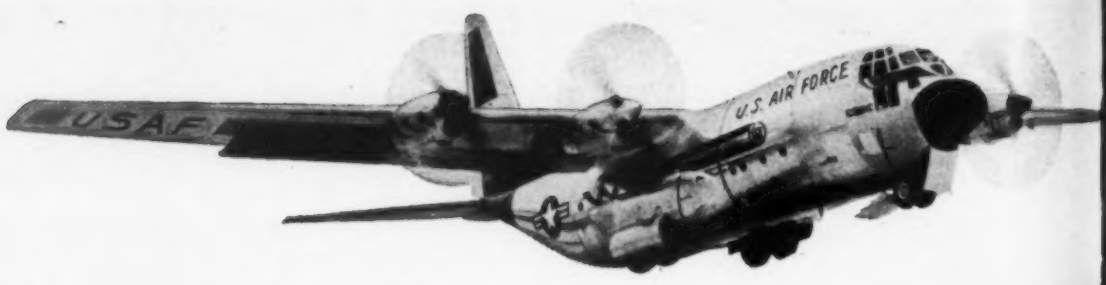

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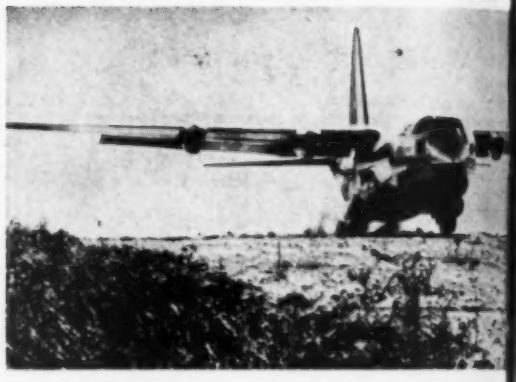

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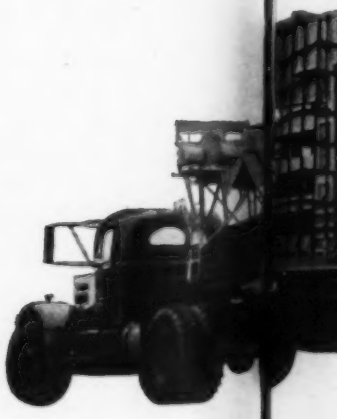

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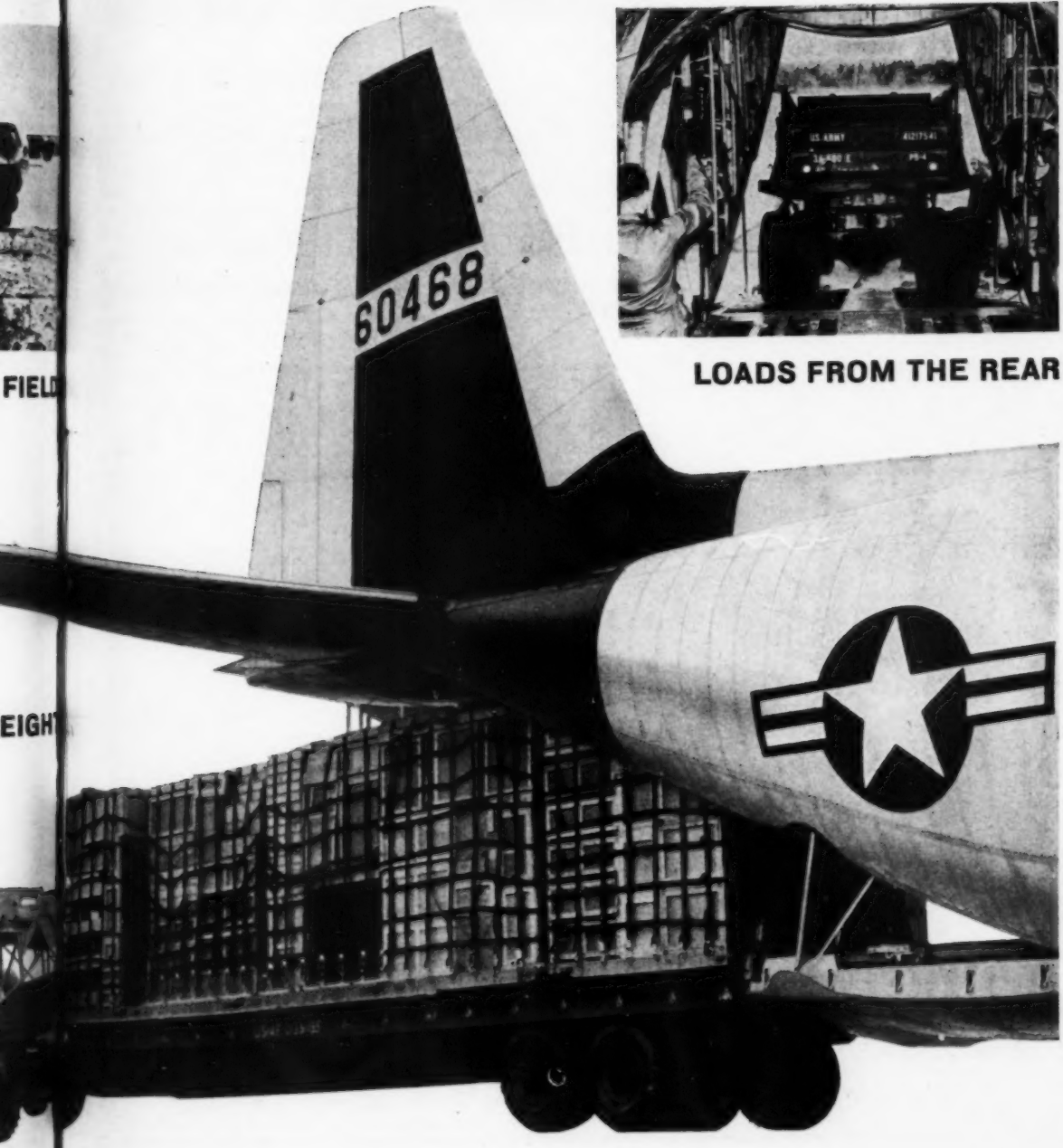

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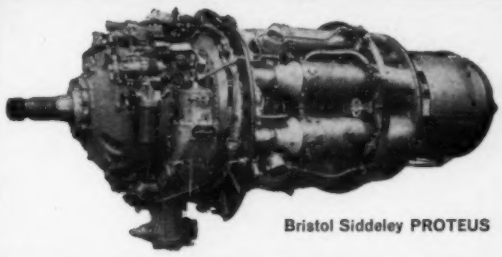

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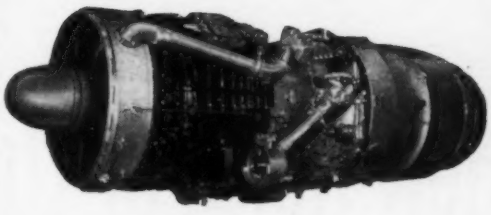

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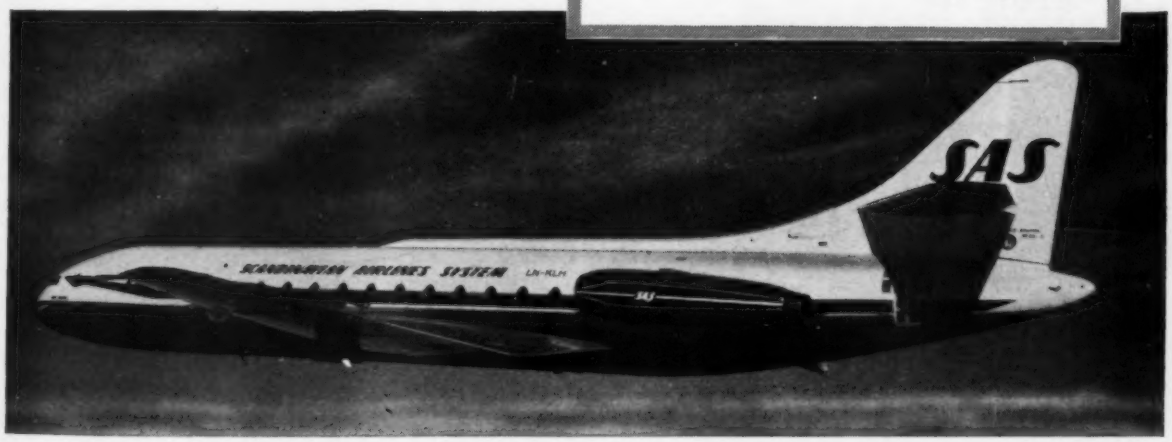

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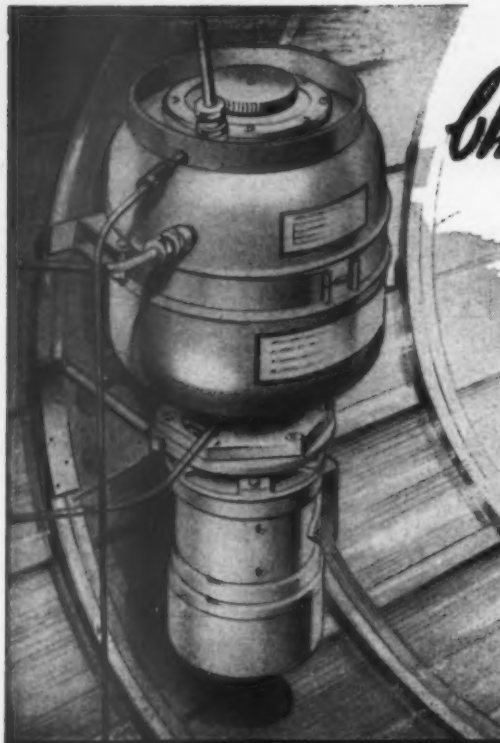

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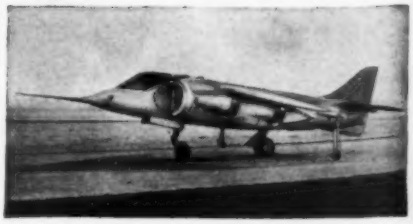

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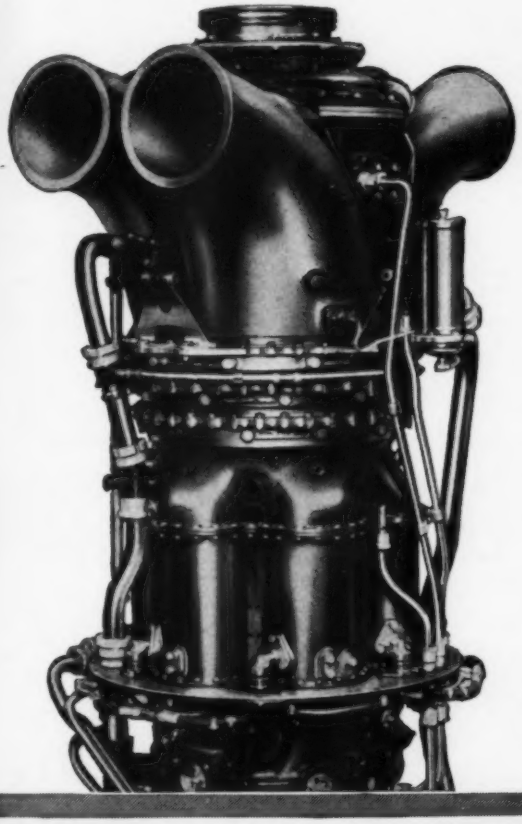

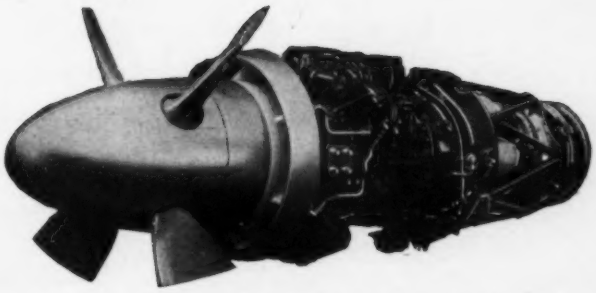

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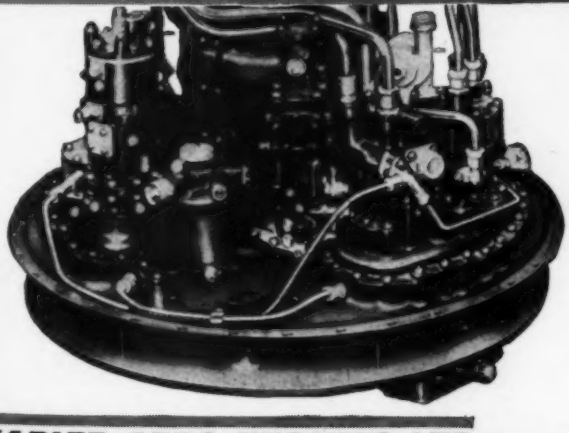

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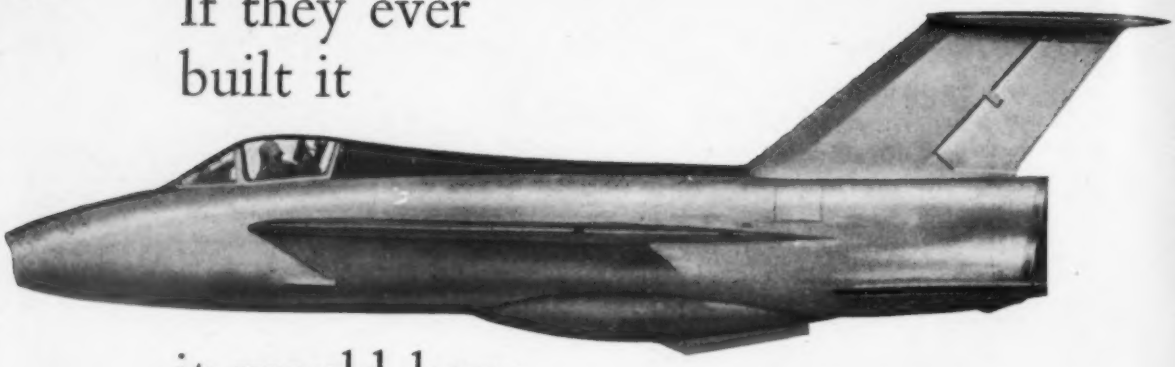

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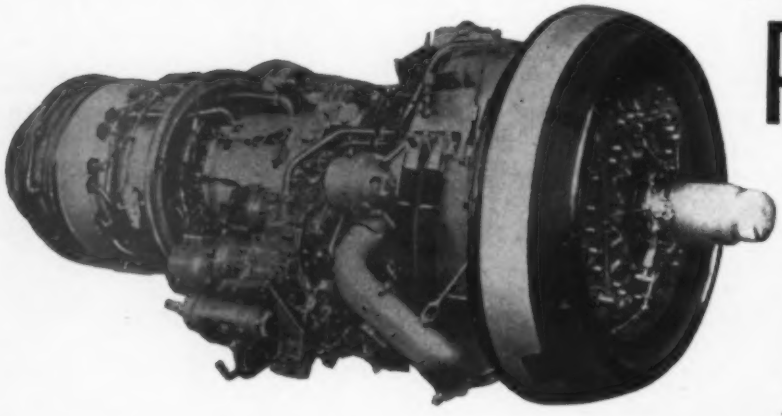

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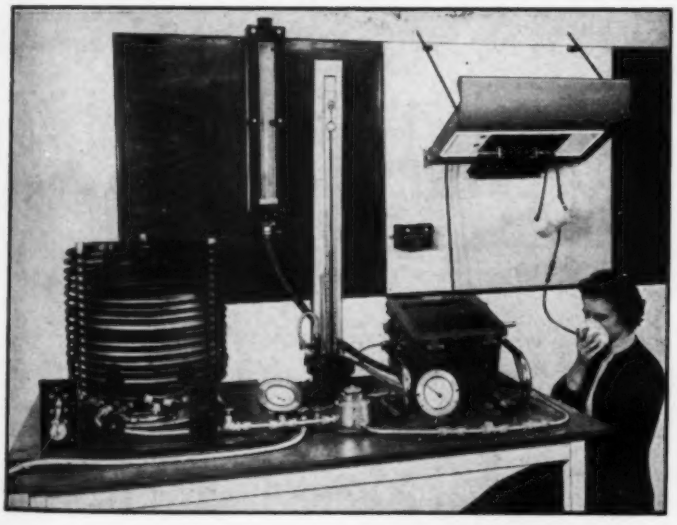

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No 2750 VOLUME 80 THURSDAY 23 NOVEMBER 1961

FLIGHT

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Majestic Burdens

ANGLO-FRENCH co-operation and France's aircraft exports—themes prominently treated in last week's *Flight*—were taken up by two national daily newspapers. On November 16 *The Guardian* discussed BAC/Sud collaboration on the supersonic airliner, and the corresponding issue of the *Daily Mail* apprised its readers that France's aircraft industry will "overtake Britain early next year." In its succeeding issue the *Mail* followed up with a leading article called "Drifting in the Air," relating France's strengthening industrial position to aspects of the British scene; and on the same day, recording the coming closure of the Gloster works at Hucclecote, that newspaper quoted a Hawker Siddeley spokesman as saying: "It was reasonable to read into the White Paper that as soon as there was a smaller number of integrated firms then orders would be forthcoming. The industry has done its piece, but there have been no orders worth talking about." Yet, turning overleaf, readers were confronted with Sir Thomas Sopwith's declaration that order books on Hawker Siddeley's aviation side are "large."

The facts are, of course, that although orders in hand are substantial, prospects for the years ahead, and in particular export orders, are far from reassuring. Within the context of redundancy they are disturbing, if not distressing. Quite apart from the difficulty of selling our existing aircraft (and they include several of the world's finest), there is the stark absence of new, Government-sponsored projects, to which Sir Roy Dobson, Hawker Siddeley managing director, has called attention. His opposite number in the British Aircraft Corporation, Sir George Edwards, has remarked that he and Sir Roy have in common "some fairly majestic burdens."

Even today it is not widely acknowledged that the regrouping of the British aircraft industry (which, when ordained, was commonly viewed as something gravely unsettling, if not disastrous) did, in fact, prepare the way for its salvation. Not only has regrouping reassured the Government, but it has facilitated co-operation abroad and strengthened our trading position. Yet even while this has been taking place the first tremors of global industrial upheavals have been felt underfoot. Not only are rival aircraft manufacturers regrouping and redeploying for new assaults on world markets, but the vast airline industry is itself the scene of massive amalgamations, realignments, pooling agreements and retrenchments.

The burdens, as Sir George Edwards remarks, are majestic. But they are the burdens not of this nation alone; and their challenge is itself majestic.

Sky Help

TWO recent code-names sharply contrast the aeroplane as weapon and as benefactor. *Skyshield II* was the test of North American air defences; *Sky Help* the aid flown to hurricane-stricken British Honduras. The former was one of many such exercises which occur throughout the year; the latter an *ad hoc* operation, mounted swiftly to save lives. There have been several such operations recently, two of them (British Honduras and Kenya) recorded in this issue. Last week we reported aid flown to flood victims in South Vietnam; the week before, the supplying of men cut off by gales in Nab Tower off Spithead; the week before that the Royal Navy's thanks to the RAF for rescuing the crew of the boom defence vessel *Barmouth*. And so it goes on. No humane task seems too difficult or distant for aircraft resolutely flown.

FIRST OF FIVE Comet C.4s for Transport Command makes its maiden flight (see news-item in column 2 below)

FROM ALL QUARTERS

BMR.3 Consortium

ON November 17 representatives of seven British, European and US companies meeting at the Hawker HQ at Kingston-upon-Thames concluded plans for the establishment of a consortium to manage their participation in the BMR.3 programme. As described in several recent *Flight* issues (e.g., October 12), BMR.3 is the NATO specification for a supersonic VTOL strike fighter.

The companies concerned are: Breguet, France; Avions Fairey, Belgium; Focke Wulf, Germany; Fokker, Netherlands; Hawker Siddeley Aviation, UK; Republic, USA; and SABCA, Belgium. The two Belgian firms are participating as a single joint company.

Under the terms of the agreement any member may submit any design to meet the requirement, and the successful tenderer will become prime contractor and design-leader. Subsequent research, development and production will be distributed between all the members of the consortium, according to their abilities, and the orders placed by the country concerned. One production line will be located at the prime contractor's works.

This agreement is extremely encouraging, for it marks an extension of the policy of international co-operation and standardization of hardware which characterizes all major NATO weapons —co-operation from which Britain had previously been conspicuously absent. It is perhaps appropriate to add that this is an agreement between companies and not between governments.

Among likely BMR.3 contenders are: a P.1127 development (Hawker/Focke Wulf); the D-24 Alliance (Republic/Fokker); the Mirage III V (Dassault/BAC); the VJ-101 (Entwicklungsring Sud); and the VTOL F-104G (Lockheed/Short).

Whitworth Gloster Closure

UNLESS Government orders "of sufficient magnitude" are received, the Gloucester works of Whitworth Gloster Aircraft, employing 4,000 people, are to be closed by the middle of next year. This decision was taken at a meeting of directors on November 13; it was reached "after full consideration of the possibility of future orders, having regard to the running-down of the existing production programme at the Gloucester works." The directors' statement added: "the only circumstances which could affect this decision would be the early receipt of Government orders of sufficient magnitude to make the continuation of the Gloucester works an economic proposition."

Whitworth Gloster Aircraft was formed earlier this year by the merger of Gloster Aircraft and Sir W. G. Armstrong Whitworth Aircraft, both members of the Hawker Siddeley group.

Hatfield's Puffin

ON pages 787-788 will be found an account, written by the designers, of the development of the man-powered aircraft of Southampton University. Its closest rival for the £5,000 Kremer Prize (for a controlled figure-of-eight round points at least half a mile apart) is the Puffin, by the Hatfield Man-powered Aircraft Club. This contender has now also begun to fly, and both the machines are running—or pedalling—neck and neck.

As might be expected, nearly all the members of the HMPAC are employees of de Havilland Aircraft; the secretary is Mr E. C. Clear Hill, the leader of the design team is Mr J. C. Wimpenny (the company's deputy chief aerodynamicist) and many of the club's members are either on the firm's staff or are apprentices at the DH Aeronautical Technical School. DH have offered the club every assistance, including the use of company facilities; but the Puffin is in no way their venture.

The club are not prepared at this stage to divulge any details of their design. The Puffin was constructed in Trident-like secrecy in the heart of the Manor Road facilities on the far side of the airfield, and during testing it has never been allowed to approach the perimeter. Nevertheless, unofficial observers are agreed that it has a very considerable span, is covered in translucent material and is propelled by a pedal-driven propeller mounted behind the tail. The structure is said to be amazingly light; overall weight is certainly very much less than the 130lb of the Southampton machine.

Roll-out took place at about 10.30 p.m. on November 15, and the aircraft remained out until midnight. During the past week it has flown on several occasions. The club will eventually choose a pilot from a number of candidates ranging from very experienced pilots to outstanding athletes, but all the flights so far have been made by DH test pilot James Phillips. At the time of writing it can be confirmed that the aircraft has shown itself to be stable and fully controllable, and it has certainly flown some hundreds of yards at a height of several feet.

First RAF Comet 4C

AT the de Havilland factory near Chester the first of five Comet C.4 (4c) aircraft for Transport Command made its maiden flight on Wednesday of last week, taking off for the company's Hatfield aerodrome, where it will undergo routine pre-delivery test flying. The aircraft are powered by four Rolls-Royce Avon Ra.29 Mk 350 engines, each of 10,500lb static thrust. These engines incorporate a new type of low-loss propelling nozzle designed to improve specific fuel consumption at cruising altitudes. Avon engines as fitted to RAF Comets now have behind them accumulated experience, both military and civil, amounting to more than 5½m hours in the air. Similar engines fitted to BOAC Comet 4s are officially approved for a life of 2,900hr between overhauls—a higher figure than that attained by any other jet engine.

The RAF C.4s will be fitted with backward-facing seats for up to 94 passengers sitting five abreast, though the aircraft can be converted to carry 12 stretchers and six sick-berth attendants, with 47 seats for sitting cases in a separate compartment aft. Like the Comet C.2s which have been operated by 216 Sqn, the C.4s will be available for a variety of duties ranging from trooping to casualty evacuation and to the carriage of VIP passengers.

FAA's Project Beacon

THE wide extent of the "rethink" in the US Federal Aviation Agency's whole policy for nagivation and traffic control is indicated by reports of the Project Beacon plans which have now been approved by President Kennedy. Among the varied group of proposals (for example, separation of VFR from IFR traffic and closer regulation of terminal areas) there are some surprising changes.

The FAA is, for instance, considering the provision of a control system completely independent of navigation information from the air. A large proportion of the highly elaborate Data Processing Central is to be abandoned in favour of less specialized computers. VFR traffic in certain circumstances would be subject to a speed limit. As for navaids, the present VOR/DME system is regarded as

FIRST OF OVER 300 Lockheed F-104G Super Starfighters to be assembled by Fokker for the Royal Netherlands and West German Air Forces made its first flight on November 11 (this page, last week). It is seen being put through its final ground checks by Fokker chief test pilot A. P. Moll. This particular aircraft has been assembled from Lockheed-made components

AT DUNSFOLD recently to watch a demonstration of the Hawker P.1127 were, l to r, Air Marshal R. B. Lees, the DCAS; Sir Roy Dobson; Sir Thomas Sopwith; Air Chief Marshal Sir Thomas G. Pike, the CAS; and Mr J. T. Lidbury

adequate for some time, but "a more precise system" may be needed for helicopter operations in terminal areas and "a more precise system" will also be needed "over a few high-density routes to permit airways to be aligned closer together." This really is an admission that VOR/DME does not provide the extent of accuracy of service required for airways traffic—a fact which was pointed out long ago.

The Data Processing Central has apparently proved too complicated; and surveillance radar, transponders and other auxiliary devices are to be introduced on an even larger scale than at present. On the other hand, SAGE, now slowly coming into use for military defence, is not to be applied to the new common civil/military system to be run by the FAA. Only the related military surveillance radars are to be used. All traffic above 8,000ft, 14,500ft or 24,000ft, according to area and terrain height, will be fully controlled and efforts are to be made to separate VFR from IFR traffic and to introduce "controlled visual rules" for pilots without instrument ratings using the traffic control system.

The whole Beacon project will cost no less than $500m over five years—twice as much as the existing plans. The research budget would remain about constant at $65m per year.

Counting the Sheep and Goats

THE first periodic census of all aircraft flying in the London, Preston and Scottish FIRS and UIRS (flight information regions and upper flight information regions) is to be held from December 4 to 10 inclusive. All aircraft, British and foreign, fixed- and rotating-winged, powered and unpowered, which are airborne on the hour at any hour are to be recorded, those in airways, zones and ADRs (advisory direct routes) by the Air Traffic Service and others by special log-cards issued individually to owners of every aircraft known to be airworthy.

The MoA has distributed convenient cards of knee-pad size, complete with a cardboard backing, on which a pilot can easily note, in flight, at each hour, these details: latitude and longitude, or geographical position; origin and destination; height to the nearest 500ft; and a number denoting whether he is engaged in transport, aerial work, training, pleasure, business or test/development. The MoA first consulted with ABAC, BAUA, BGA, BIATA, IATA, PFA, RAeC and SBAC, all of whom agreed to help. Individual returns are to be treated as confidential.

The census will be repeated each summer and winter, possibly for less than a week at a time. It has been suggested (needless to say, not in Ministry circles) that as many private aircraft as possible should take to the air frequently during the census week in order to avoid giving the impression that uncontrolled airspace is not much used and can be assimilated into zones and airways. Only recently, MoA appropriated a very large slice of uncontrolled airspace east of the London Terminal Area as additional manœuvring space for radar sequencing. The network of cross-Channel service routes between Southend, Le Touquet and Rotterdam now combine with the extended TMA to form a complicated barrier for VFR flying over South East England.

IN BRIEF

The Duke of Edinburgh is to attend the ceremony of laying-up the standard of 601 Sqn, RAuxAF, at St Clement Danes Church on Tuesday, December 19. The duke was Honorary Air Commodore of the squadron before its disbandment.

The Guild of Air Pilots and Air Navigators is to hold its fourth livery dinner at Innholders' Hall, London EC4, on Wednesday, January 10.

Nine new West German Air Force squadrons are being formed, some of which should be in service early next year. One is of F-104Gs, three of Fiat G.91s, three of F-86s and F-86Ks and two of Noratlas transports.

Production of the Scottish Aviation Prestwick Pioneer has now ceased, after 14 years, during which 56 of these aircraft have been sold. Production of the Twin Pioneer, 90 of which have so far been sold, is continuing. Ten are at present being built for the Malayan Air Force.

The president's medal of the Photogrammetric Society was being presented to Mr J. A. Eden, ARICS, at the society's annual general meeting last Tuesday. At the meeting, Mr Eden was giving a paper entitled *Some General Observations on Photogrammetry*.

The Canadian Aeronautical Institute and the Canadian Astronautical Society are to merge, and will be known as the Canadian Aeronautics and Space Institute. Headquarters will remain at 77 Metcalfe Street, Ottowa, the present offices of the Canadian Aeronautical Institute.

The Canadair CL-41 jet trainer recently returned to Montreal after its six-week sales demonstration tour in Europe. Ninety-six flights were made for air force and airline pilots, and government officials in Sweden, Germany, Holland, Belgium and Switzerland. The first of 190 CL-41s for the RCAF is due to go into service in 1963.

Dr J. V. Dunworth, CBE, has been appointed Deputy Director of the National Physical Laboratory in succession to Dr G. Macfarlane, who is shortly taking up the appointment of Director of the Royal Radar Establishment. Dr Dunworth is at present Deputy Director of the Atomic Energy Establishment at Winfrith.

At the inquest in Weymouth on the crew of a Blackburn Buccaneer which crashed on take-off from the aircraft carrier *Hermes* on August 31 it was stated that the pilot might have been distracted by a fault in the wing-locking warning system. Cdr R. Glendinning, who was in charge of the MoA investigation, said that this would have caused him either to apply more trim than was intended or to have delayed corrective action. Verdicts of accidental death were returned on the pilot, Lt Cdr Oswald Brown, and the flight test observer, Mr T. D. Dunn.

First flights of the Slingsby T.49 two-seat sailplane were made at Wombleton Aerodrome, near Kirbymoorside, Yorkshire, on November 4. C of A flight tests are currently taking place at Lasham.

Mr C. J. Wegerif, a director of Dowty Rotol Ltd and deputy managing director of Dowty Marine Ltd, has been appointed sales director of Dowty Rotol Ltd. He will be responsible for the company's commercial, sales and service departments.

Lockheed Aircraft Corporation report a net profit for the first nine months of 1961 of $16,502,000 (£5,893,571). Sales for this period totalled $995,442,000 (£355,515,000), compared with $962,298,000 (£343,677,857) for the same period last year.

United Aircraft Corporation have now established a Corporate Systems Center at Windsor Locks, Connecticut. Managed by Charles M. Kearns, styled vice-president for corporate systems, the facility is to "develop, manage, and produce complex space, missile, and other military systems."

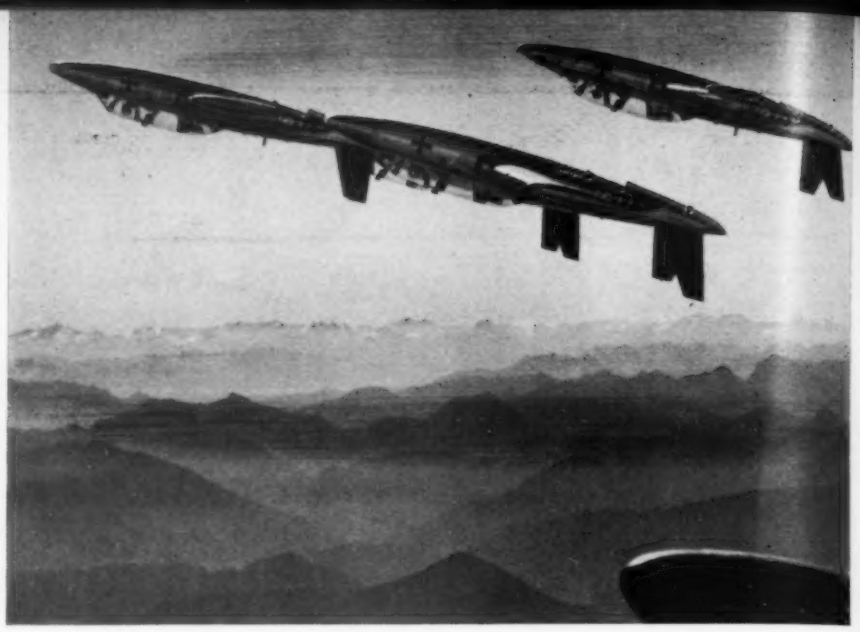
Two new orders have been announced by Saab. One is a contract with the Finnish Air Force for five 91D Safir trainers, the third Finnish order for the 91D. The other is an order placed with Saab as Scandinavian distributors for Sud-Aviation helicopters, for five Alouette IIIs for the Danish Air Force. This is the first order received by Saab for the new Alouette III.

A painting of the Avro 707 research delta aircraft was presented to Mr S. B. Oliver, chief test pilot of Hunting Aircraft, on the occasion of his installation on November 9 as new president of the London Society of Air-Britain. The painting is the work of Mr Kenneth McDonough, a member of the Industrial Artists Group (formerly the Society of Aviation Artists).

Mr John Stroud—well known to readers of *Flight* as a contributor to its pages—has succeeded Mr Owen Thetford as general editor of *Putnam's Aviation List*. Mr Stroud was with Imperial Airways in the early 1930s, and has worked as an aviation journalist and artist ever since; since 1945 he and his wife Patricia, have concentrated on commercial air transport. His next book, *Annals of British and Commonwealth Air Transport*, will be published by Putnam next spring.

The USAF is claiming further world records for the Kaman H-43B Huskie (T53 Lycoming). On October 18 Lt-Col Francis M. Carney reached an altitude of 32,279ft, and a week later he registered the following figures for helicopter time-to-height records; 3,000m (9,842ft), 2min 44.5sec; 6,000m (19,684ft), 6min 42.3sec; 9,000m (29,526ft), 14min 11.5sec. An Alouette holds the 9,000m record which has stood at 17min 43.9sec since June 1958. The Huskie's initial rate of climb is higher than that of any operational World War II fighter.

FROM ALL QUARTERS . . .



DIE MEISTERFLIEGER: Fouga Magister-mounted members of the Anglo-German aerobatic team formed at Landsberg, Bavaria, where the RAF Mission to the German Air Force is based, in action (above) and on the ground. From left to right: Flt Lt R. Hoggarth (leader), Flt Lt Forster, Maj E. Willie, Fg Off D. W. McSweeny, St Fw H. Haeger and Hpt Fw E. Czullay. A photograph of an Anglo-German Fouga Magister formation of 16 aircraft, mounted in honour of a visit by the CAS to the RAF mission, was published in "Flight" for October 12

Aiding Kenya

MORE airborne aid was sent to Kenya last week, following an SOS from the Governor, Sir Patrick Renison, when four RAF Beverleys flew out carrying four Sycamores, which had been partially dismantled for loading inside the Beverleys. Extra crews had been sent on ahead, so that all the aircraft could start operating as soon as possible after arrival at Eastleigh, Nairobi: they are being used to drop food to starving villagers cut off by floods, and to rescue the sick and dying. Beverleys based at Eastleigh and Aden are already engaged in supply-dropping; Royal Rhodesian Air Force Dakotas have also co-operated; and the part played by RAF Twin Pioneers in Kenya relief is referred to on page 798.

Discussing Aerial Farming

AN all-day meeting on *Uses of the Aeroplane in Agriculture* has been arranged by the Agricultural Aviation Group of the Royal Aeronautical Society and is to take place on Wednesday, December 13, in the lecture theatre at 4 Hamilton Place, London W1, from 10 a.m. to 5.30 p.m. Four lectures are being given, each of which will be followed by a discussion. Wg Cdr P. R. Hatfield of Airspray (Colchester) Ltd is speaking on *The Operator's Year*; Dr Myles Crooke, of the Department of Forestry at Aberdeen University, on *Aerial Treatments in Forest Areas*; and Prof J. W. Calder, of Twyford Seeds Ltd, and Mr H. M. Lawson, advisory agronomist to Dow Agrochemicals Ltd, on *Chemical Cultivation and Re-seeding from the Air*. Three other speakers will be giving short talks on *Agricultural Aircraft for the Future*—Capt J. Summerlee of the BEA Helicopter Experimental Unit on the helicopter, Mr K. H. Greenley of D. Napier & Son Ltd on the gyrocopter and a lecturer (to be announced) on fixed-wing aircraft. Discussions will follow each of these talks.

Norair N-156 Family

ACCORDING to the US *Aviation Daily*, Northrop Corporation is "stepping up promotion" of the N-156 light supersonic fighter, which was fully described in *Flight* for January 8, 1960. Norair Division are trying to sell two advanced versions. The N-156C would be a multi-purpose day aircraft, capable of fulfilling a variety of missions merely by fitting alternative nose sections and appropriate plug-in equipment. More fundamental changes could lead to the N-156D (larger wing, more fuel, greater pylon loads and equipped for carrier operation), and the ultimate N-156E, which would have 6,800lb-thrust afterburning versions of the GE CF-700 aft-fan engine.

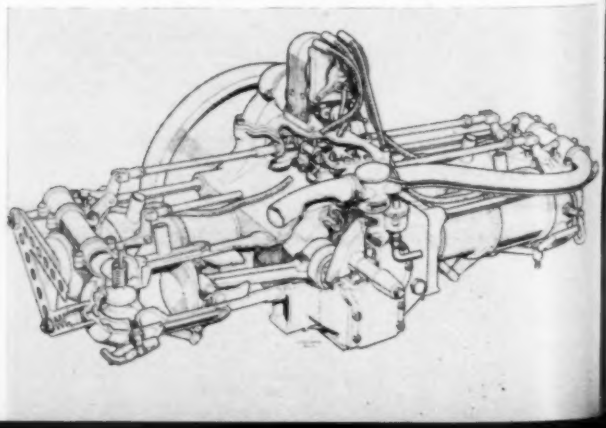
Sipa Antilope with Astazou

NOW under construction at the Sipa factory at Suresnes is the Sipa 251 Antilope, a 300 m.p.h., four-seat executive aircraft powered by a single 560 h.p. Turboméca Astazou turboprop. The design has been prepared in conjunction with the Italian company Procaer, and the 251 Antilope to some extent resembles the Picchio. The structure is, however, all metal and tip-tanks are fitted. Principal characteristics are:

Span, 32ft 10in; length, 27ft 7in; wing area, 145 sq ft; empty weight, 1,670lb; gross weight, 3,180lb; wing loading, 20lb/sq ft; weight/power ratio, 5.7lb/h.p. Performance: maximum speed, 318 m.p.h.; cruising speed, 306 m.p.h.; stalling speed, 66 m.p.h.; take-off distance to 50ft, 820ft; initial climb, 3,120ft/min; range, 1,030 miles.

TWO DEREKS were honoured at the Air Public Relations Association reunion last Thursday when Derek Wood (centre) and Derek Dempster (right), co-authors of "The Narrow Margin," a study of the Battle of Britain, received the C. P. Robertson Memorial Trophy, awarded annually for the best presentation of the RAF to the public. It was presented to them by the Secretary of State for Air, Mr Julian Amery (left)

POWERPLANT RE-BORN: Last week we related how Sir Geoffrey de Havilland, together with founder-members of his company, met recently at an informal ceremony to start-up a replica of the 45 h.p. de Havilland flat-four aero engine of 1910. The replica—shown in this small reproduction of a D.H. drawing—was built by company apprentices as part of their training, using drawings which appeared in a 1910 issue of "Flight"



A photograph taken during the initial stage at Lasham; the 80ft span dwarfs all conventional sailplanes

Southampton's Man-powered Aircraft

THE idea of designing a man-powered aircraft arose during a maths lecture in the spring term of 1960. Design work began in earnest the day after finals at Southampton University in the following July. By the end of September the project design was complete, and a report was submitted to the Man-Powered Aircraft Group Committee of the Royal Aeronautical Society, in the hope of receiving financial help which had been announced by the committee as being available. Support was given to the project by Prof Richards and the department of Aeronautics at Southampton, and detail design and planning was started. Construction started in January 1961 and was finished in September. Meanwhile, a promise of a grant of up to £1,500 was received from the Royal Aeronautical Society in February, and without their help the achieved rate of progress would not have been possible.

Since early September trials have been carried out at Lasham Gliding Centre, with Derek Piggott, the chief flying instructor, as pilot. After many ground tests and "hops" the first real flight took place at 4.30 p.m. on Thursday, November 9, 1961, at Lasham, as reported in *Flight* last week. The flight was seen by a number of independent witnesses, who were almost as surprised as the designers. The flight speed was fairly constant during the climb, thus showing that the height was achieved by propeller thrust and not by using kinetic energy attained during the ground run. The flight was thus a true unassisted take-off and flight under man-power alone.

The design work started with horsepower tests on members of a local cycling club. A reclining seated position, taking the reaction of the leg thrust on the back and leaving the hands free to apply control movements, was found to be satisfactory both for power output and control, and also proved to be comfortable. The results of these tests confirmed the work of Dr Wilkie, as reported in the *Journal of the Royal Aeronautical Society* (August 1960). These results also meant that a fuselage with low frontal area and good forward vision could be constructed. A conventional high-wing monoplane was chosen, rather than a helicopter (which is less efficient), or an ornithopter (about which little is known), the aim being to have an aircraft flying as soon as possible. Although the aircraft relies on ground effect, it was considered that a low-wing configuration would gain little, and increase the problem of tip clearance while the aircraft was on the ground.

Conventional materials, i.e., wood and fabric, have been used in preference to some of the newer materials such as plastics, because of the great difficulty in using the latter efficiently. For example, Durestos could have been used for the spars, but for the curing process required. However, a limited use of expanded polystyrene has made for the tips of the flying surfaces.

The horsepower required for level flight depends on wing area, weight, C_L and C_D. Variations were played on the size and shape of the wing and other structure until what appeared to be the optimum design was found, requiring about 0.4 h.p. to be exerted by the pilot to sustain steady level flight.

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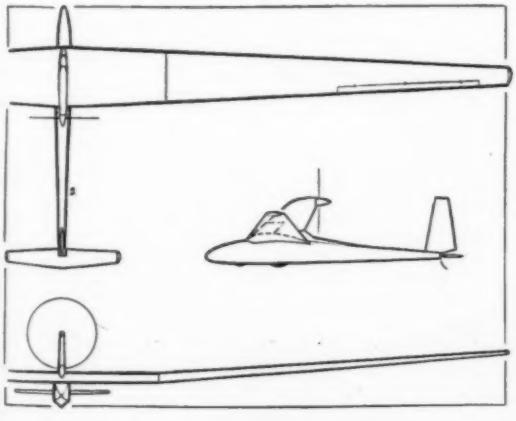


Since there seemed to be no obvious advantage in a two-seater—except for power continuity—a single-seater was preferred, on account of its simpler configuration. A major consideration in the design was ease of construction with a minimum of jigging.

Wind-tunnel tests on a $\frac{1}{6}$-scale model were carried out at full-scale Reynolds number, in order to check the drag and to measure lift and pitching moment. After suitable fillets had been added to improve the flow at the pylon/wing junction, the measured lift and drag agreed closely with the calculated values. As mentioned in last week's *Flight*, a two-dimensional wing section was made in order to develop a practical method of wing construction. This section was subjected to a large number of structural and aerodynamic tests, and from these the construction used in the actual wing was evolved. It was found possible to maintain laminar flow up to 60 or 70 per cent of the chord by careful smoothing of the leading-edge profile, using $\frac{1}{16}$in balsa sheet covering up to 20 per cent chord.

BY THE DESIGNERS

For ease of transport and ground handling, the wing was made in three sections. Two spars were used, as this simplified the problem of jigging and incorporating aerodynamic twist. The spars were made from laminated spruce with girder webs, and were joined by cross-bracing to form a torque box resulting in a wing which was extremely stiff in torsion. The ribs were of the girder type made in spruce and balsa, as this proved to be the lightest form of construction. Conventional ailerons were constructed integral with the wing and detached later, thus avoiding a separate aileron jig.

All the metal fittings were bonded to the wood by Araldite epoxy resin, and elimination of bolts resulted in a great weight-saving. The remaining structure is entirely glued using Cascamite urea-formaldehyde synthetic resin. The construction of the fin and tail-plane is similar to that of the wing, the whole surfaces being made to move to improve control and simplify construction. For the fuselage a basic slab-sided box section with light fairing was chosen for ease of construction; and, in any case, the fuselage is very small compared with the wing, so that any improvement to be gained by using a more elegant shape was not considered worthwhile. The nose fairing is removable to allow the pilot to climb into the seat, which was placed between the front and rear wing spars to obtain the correct c.g. position. The pilot is well protected against injury, since the spars are the strongest part of the structure.

All the main loads due to landing, the drive mechanism and the propeller thrust are taken on a light-alloy structure to which the wing and fuselage are bolted. The framework has been considerably modified as a result of initial undercarriage difficulties. It now consists of a 27in racing cycle wheel at the rear and a 9in light-alloy at the front. The latter is sprung and is free to castor.

The most severe problems have been met with the drive mechanism. It consists of a $\frac{3}{16}$in Renold chain to drive the back wheel from the pedal cranks, and a twisted flat steel belt to drive the propeller shaft from the back wheel. The belt, which is 0.008in thick spring steel, is joined by two rows of spot welds and annealed in the region of the weld. In order to increase the coefficient of friction, and hence reduce the initial tension required in the belt, it is coated with "belt-stick." A flexible shaft drive is used at the top of the pylon to tilt the thrust axis through a small angle. The propeller is permanently geared to the back wheel, which can free-wheel relative to the pedals. This may influence the output by the pilot, but is a precaution against possible shock loads on landing.

The propeller has a light-alloy tubular spar and sheet metal ribs. The space between the ribs is filled with solid balsa, bonded to the ribs with epoxy resin. Tests under full-scale conditions were made on the propeller in the low-speed section of the 7ft × 5½ft tunnel at Southampton University. The cruising speed for the propeller is

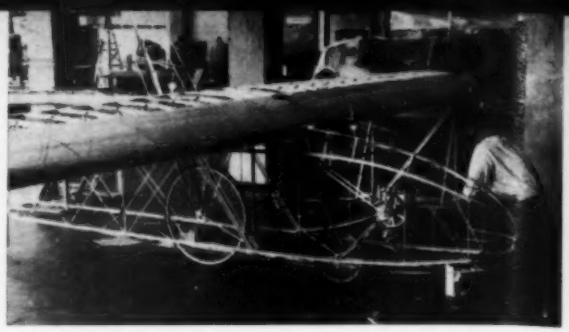
Southampton's Man-powered Aircraft . . .

240/250 r.p.m. at the cruising forward speed of 30ft/sec, which accounts for the high geometrical pitch.

All three controls are mounted on one control bar actuated by the hands. The senses of the controls are conventional, the rudder control being superimposed on the aileron and elevator controls. The control bar is positioned in the wing leading edge; the pilot's hands go through the front spar web and his elbows are supported by rests in the wing. This position seems to be the only one possible in the limited space. Many types of covering were considered, and eventually parachute nylon was chosen because of its strength and lightness (2oz/sq yd, doped). Ordinary glider dope was used to tighten the fabric; at first only two tightening coats were used, but it was subsequently found necessary to use two more coats—in spite of the weight penalty—because of the slackening effect of the damp atmosphere.

For initial trials, skids were fitted at the wing joints to protect the wing tips, and these have already prevented a considerable amount of damage. The tailplane is protected from contact with the ground by a tail skid attached to a fuselage longeron. The final weight of the aircraft is approximately 130lb, which compares well with the design estimate of 124lb.

No trials have been tried so far using a tow car or a small engine, as has been suggested, since the problem of producing power is at this stage secondary to that of controlling the aircraft; in fact Derek Piggott has said the take-off was a fairly easy matter as regards supplying the necessary power.



This early configuration, which was modified after initial taxying trials, may be compared with the final design sketched below

One of the inherent problems of an aircraft of this nature is its high inertia about the rolling and yawing axes, and its small control forces. This means that the response of the aircraft to control movements in the lateral plane is slow, and when flying close to the ground this can be serious. If either a swing or roll develops it could cause a wing tip to touch the ground before the controls can act. This seems to be the most likely explanation of the ground loops which have been experienced. Development of the machine is continuing.

ANNE MARSDEN, DAVID WILLIAMS, ALAN LASSIÈRE

Evolution of the aircraft, discussed in the accompanying article and in last week's issue, has finally led to this configuration. The central inset shows how three-axis control movements are passed through a "handlebars" mounted in a universal ball-joint, and thence through key rings to nylon fishing-lines. The words "adjustable tip" in the smaller drawing refer to small extensions added to the original propeller. The key to the drawing is:—

1, flexible propeller drive; 2, nylon tension-roller for 0.008 × 0.5in steel belt; 3, high-pressure 27 × 1.75in tyre, freewheel hub; 4, propeller drive pulley; 5, racing-type 3/32in chain and light-alloy chainset; 6, levered-suspension nosewheel; 7, light-alloy tubular frame; 8, control column; 9, leading edge 1/16in balsa sheet; 10, aircraft covered in parachute nylon (approx 700sq ft, weighing 6lb); 11, Sitka-spruce ribs, Cascamite one-shot glued, balsa capping strips; 12, light-alloy sheet; 13, hand-holes to control crossbar; 14, light-alloy tubular pylon; 15, ground-adjustable propeller (for construction see text)

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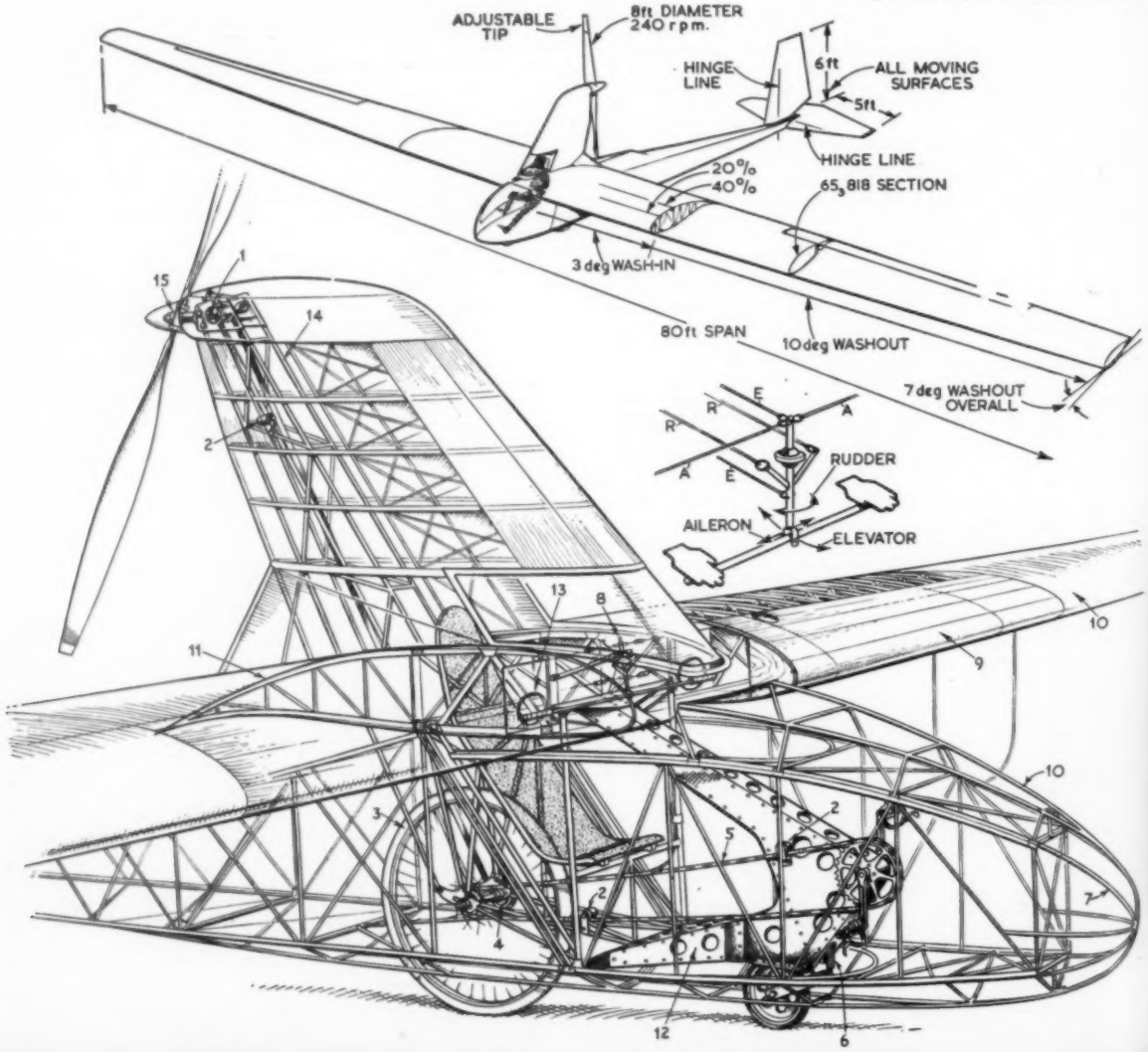
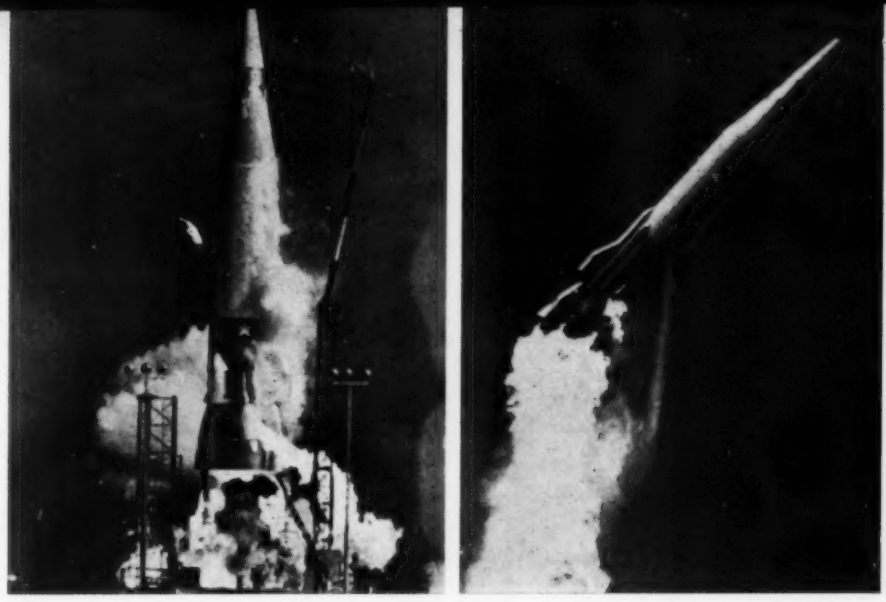




The abortive launch of a USAF Atlas E missile from Cape Canaveral on November 10, reported in last week's issue, is dramatically illustrated in these two pictures. A squirrel monkey was carried in the nosecone of the rocket, which was intended to make a 5,000-mile flight down the Atlantic Missile Range from the Cape

Missiles and Spaceflight

TITOV ON FILM

Good-quality orbit-to-ground pictures and the sight of an actual Soviet rocket-exhaust are among the attractions of *Again to the Stars*, the colour film of Maj Herman Titov's flight, which was shown privately at the Soviet Embassy last week prior to its general release in this country. Broadly similar in approach and content to the Gagarin film, the new production offers a few extra technical titbits and a glossier, almost Hollywood style, with the muscular Major showing himself a worthy Tarzan-type star.

"Extensive physical and psychological training, sometimes in very difficult conditions "included bouncing on a trampoline, swinging on a man-sized version of a child's swing—but simultaneously rotating about his own longitudinal axis as well as about the cross-bar of the swing—and balancing on the edge of a large, flat, tilting disc.

Wearing cute light-blue shorts, and wired for heartbeat, Maj Titov makes a speed of some 5km/sec while running on an endless belt. He is placed in a test capsule which is then rotated simultaneously and rapidly about three axes—answering questions, we are told, the while. In an isolation chamber he experiences complete silence for "many, many days," dreaming of his childhood and unexpectedly reciting verses by Pushkin.

He becomes familiar with the interior of a Vostok 2 cabin mockup. The spaciousness of the cabin is emphasized as he has to lean forward and upwards from his seat, stretching out his arm to adjust the position-indicating instrument which incorporates the small central globe.

After centrifuge training comes practice seat-ejections from a tower, and from a modified Il-28 aircraft. One sequence in the film gives a close-up of the rocket ejection from the Il-28. We see Maj Titov, but not his spacecraft, descend by parachute into the sea, and float around in an inflated dinghy.

He has a serious talk with his doctor. What did he think about his training? How did he feel about Gagarin's flight? As he watched Gagarin's launch, Titov says, he was worrying for his friend. A "special medical and scientific commission" considers whether Maj Titov is ready to go into space, concludes that he is, and its chairman signs the appropriate papers.

At the launch site, transparent overlays scribed with orbital sine-curves are moved over map tables, and checks are made that ground stations, "ordinary ships" and "special ships" are standing by. After pre-flight medical tests similar to those shown in Gagarin's film, the cosmonaut gets into his blue inner suit, orange outer suit and helmet, and the launch-pad bus. Immediately behind him in the bus sits the anonymous "Cosmonaut No 3," also fully clothed for flight. In case of emergency prior to launch, he would take over.

The launch pad itself is familiar to those who saw the Gagarin film. Farewell greetings from his khaki-shirted colleagues; the climb up the steps to the lift platform; the inclined upward journey in the lift.

In the Vostok, Titov checks his communications and pulls on his gloves. Meanwhile, in a large room which is clearly not a control centre but might be intended to give that impression, two large wall maps light up and people sitting at long tables appear to be preparing to be busy. Back to the pad, or to *a* pad, where the orange exhaust of a single-chamber rocket is seen firing down from a raised framework, and clouds of smoke and steam arise.

As the vehicle rises (modestly keeping its bottom end concealed behind the clouds of smoke) those among the audience who saw the Gagarin film are again faced with a familiar friend—the same type of launch vehicle which was depicted as having launched Vostok 1. On the evidence of the two films, the vehicle shown is not the vehicle which launched Vostok 1 and/or Vostok 2. It bears a strong resemblance to the short-range Soviet ballistic missile which has been publicly shown in May Day parades in Moscow since 1957.

Separation of the spacecraft from the rocket is indicated in the film by a blurring of an oscilloscope trace. A model of the Vostok, shown against a dark sky background, is seen to have a blunter nose than previously indicated, a liberal supply of whip and "paper-clip" aerials, the annulus shown in the large model carried under the Mi-6 helicopter at the Tushino air show, and two fin-shaped panels protruding from opposite sides of the central body of the spacecraft.

As the progress of the flight is recounted, the most fascinating sequences in the film are the pictures of the Earth stated to have been taken by Maj Titov from the cabin of his spacecraft. Black-and-white stills pictures have been published previously, but the colour is here seen to add a new dimension. No recognizable coastline is evident, but straight-edged areas of subdivided land—possibly large farms—are visible in at least one shot.

If the sequence purporting to show Titov and parachute immediately after landing is genuine, which it is not, he must have descended within about one yard of the highly skilled camera crew engaged in filming *Again to the Stars*. Notwithstanding the added and acted scenes, however, this is a well-made and fascinating film of an impressive achievement.

KENNETH OWEN

Maj Robert White (centre) is congratulated by Col Charles Yeager (left) and Brig-Gen Irving L. Branch, commander of the Air Force flight test centre at Edwards AFB, after his 4,093 m.p.h. flight in the North American X-15 research aircraft on November 9 (reported last week)

Missiles and Spaceflight . . .

RUSSIA'S PACIFIC TESTS

ON September 11 the Soviet Union announced: "Soviet scientists and constructors have prepared for testing more powerful and perfected variants of multi-stage carrier-rockets for space purposes. Launches of these rockets without final stages will be carried out into a region of the central part of the Pacific Ocean bounded by the following co-ordinates:

North latitude	10°20′ 9°10′	11°30′ 8°05′
West longitude	170°30′ 166°45′	167°55′ 169°20′

Launches will be carried out in the period from September 13 to October 15."

A series of eight tests ensued, the period being extended to October 30. Surprisingly little attention has been devoted to the series, despite its obviously outstanding interest. Apparently this is because Western news agencies have not been able to make much out of the brief Russian communiques. As reported in the West they have all sounded much the same; but close attention to each communique reveals that this is far from being the case. The purpose of this article is to build up a picture of the test series, chiefly on the basis of these communiques.

The area designated in the Pacific is approximately diamond-shaped. The side facing the Soviet Union is 253.5km long. The other sides, in clockwise order, are 287km, 306km and 299.5km. The area lies not far from the course along which both Vostoks emerged from Russia. Was this test series also launched from Baikonur? The communiques invariably describe the range involved as "over 12,000km"—with one immensely significant exception as we shall see. The town of Baikonur is at 47°46′ N, 66°01′ E, but the "Cosmodrome" must be a considerable distance away. In their record claim to the FAI the Russians gave the location as 47°N, 65°E—an obvious approximation, but the most accurate figures we can use. To the *central* part of the designated area the distance along a great circle is 11,800km. It is difficult to reconcile this with Baikonur. But an important factor is where in the diamond area the rockets fell. *Flight* would be grateful for any information which readers may have; US ships observed the tests and reports are understood to have been published. Provisionally we may conclude that the rockets came from the general region of Baikonur, and passed fairly closely over the route of the Vostoks. Doubtless this is a range uniquely equipped for telemetry and communications. The communique issued after the third launching supports this deduction.

The first launch came on September 13. Four days later came the second, and four days later the third. There was now a 16-day break before launches were resumed at a comparable rate. Thus the first three launches form a group by themselves, and the last five form a second group. This grouping becomes especially clear from the contents of the communiques. The first group has the character of proving-out a "new, more powerful multi-stage carrier-rocket" to the stage of complete readiness for launching spaceship-satellites. The first two launches are straightforward trials, the third a conclusive verification of reliability. Here are significant excerpts from the first launch communique: "a new, more powerful multi-stage carrier-rocket" . . . "the action of all its stages" . . . "the model of the final stage reached the water surface with a deviation less than 1km" . . . "the penultimate stage, having functioned, was destroyed in entering the denser layers of the atmosphere." Clearly it is at least a three-stage rocket, and the final stage is a known quantity. Probably it is the same final stage as used with the Vostoks, possibly the same as with the Luniks.

The second launch communiqué is virtually a repeat of the first. The model of the final stage fell in the immediate vicinity of the point of impact of the first.

But the third launch plainly brings the group to an end. Its importance merits full translation of the communique:

"On September 21 of this year in the Soviet Union the scheduled launch of a carrier-rocket into the central part of the Pacific Ocean was successfully carried out.

"The aim of the launch was the verification of the reliability of a new carrier-rocket and the accuracy of its system of guidance, and also the working-out of the interaction of the automatic measuring complex and means of communication for placing spaceship-satellites into orbit in the future.

"The model of the final stage of the rocket, adapted for passage through the dense layers of the atmosphere, reached the water surface of the ocean with high accuracy relative to the point aimed at.

"Launches of carrier-rockets in the earlier-designated area will be continued in accordance with the intended plan."

Here we have then a new, more powerful carrier-rocket ready in every respect for a new phase in the Soviet space programme. And obviously, if any launch in the series came from the Baikonur Cosmodrome itself, this dummy run for orbiting a spaceship is the logical choice. Surprising corroboration is the fact that for this launch alone the distance "over 12,000km" is not quoted.

The series is now broken for 16 days. Its resumption is announced in the longest and most informative communique of all issued in connection with the tests. Here is a full translation:

"In accordance with the intended plan, on October 7 of this year in the Soviet Union at an exactly determined time, there was carried out the successful scheduled launch of a multi-stage carrier-rocket of a new type into the central part of the Pacific Ocean.

"The flight of the rocket and the work of all its systems and stages went strictly in accordance with the set programme.

"A fundamentally new system of guidance ensured impact in the given region with very high accuracy.

"According to the data of the system of measurement, the model of the penultimate stage of the carrier-rocket reached the water surface in the immediate vicinity of the intended point of impact.

"The distance of the point of impact from the place of starting was greater than 12,000km.

"Special vessels in the central part of the Pacific Ocean, equipped with various measuring apparatus, made all the measurements called for by the programme.

"With the object of further accumulation of experimental facts, launches of new powerful carrier-rockets in the earlier-designated area will be continued."

Soviet Rocket Tests September-October 1961

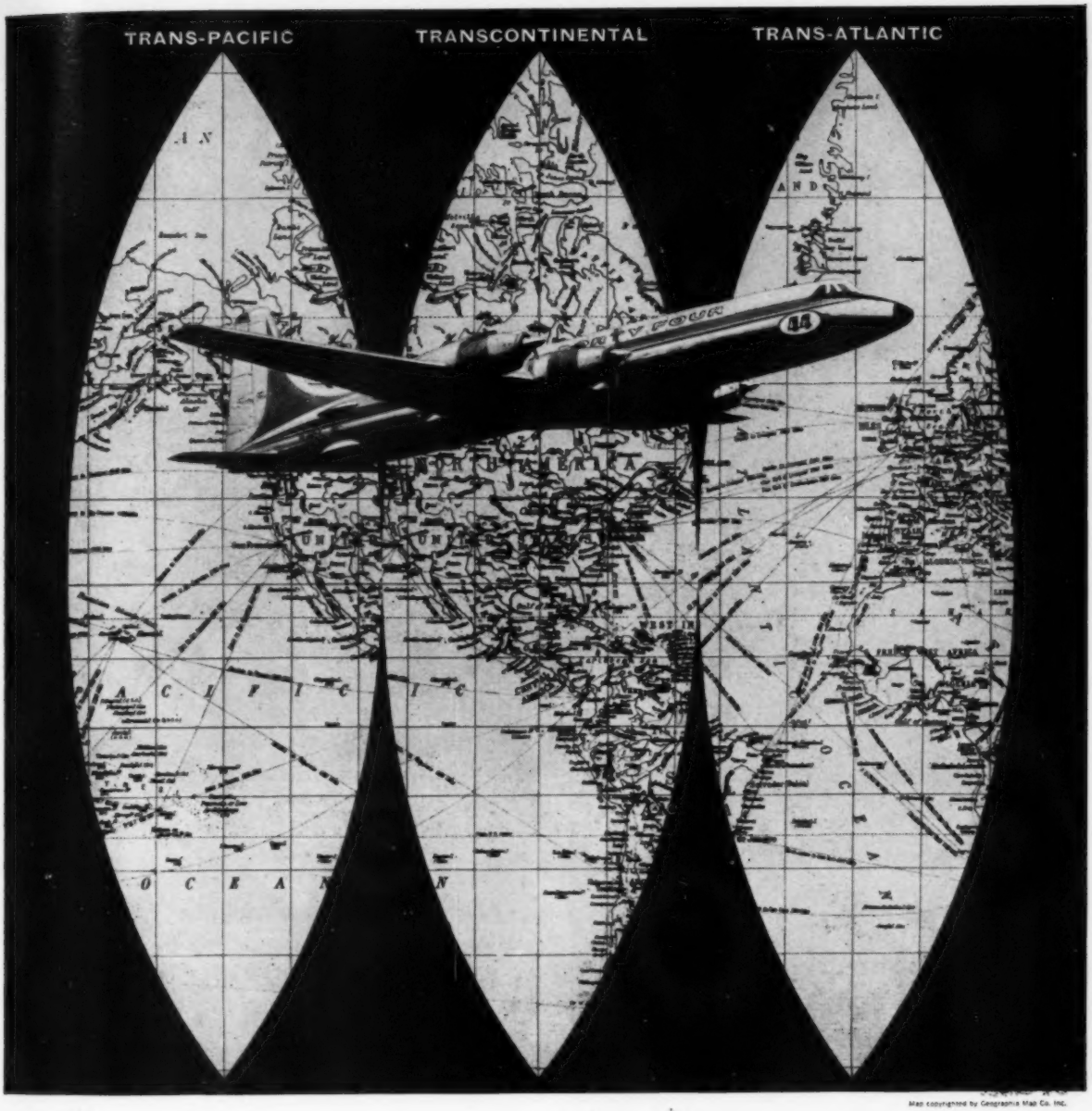
No.	Date	Days since previous test	Final stage	Penultimate stage	Range (km)	Accuracy
1	Sept 13	—	Model re-entered	Destroyed in atmosphere	Over 12,000	Deviation less than 1 km
2	Sept 17	4	Model re-entered	—	Over 12,000	Immediate vicinity of impact of (1)
3	Sept 21	4	Model re-entered	—	Not stated	High accuracy
4	Oct 7	16	None	Model re-entered	Over 12,000	Very high accuracy. Immediate vicinity of point intended
5	Oct 12	5	None	Model re-entered	Over 12,000	High accuracy. Immediate vicinity of point intended
6	Oct 15	3	None	Model re-entered	Over 12,000	High accuracy. Immediate vicinity of calculated point
7	Oct 22	7	None	Model re-entered	Over 12,000	High accuracy
8	Oct 28	6	None	Model re-entered	Over 12,000	High accuracy

Apart from the reference to a fundamentally new type of guidance and the exceptional emphasis on the accuracy achieved, the re-entering body has now become *a model of the penultimate stage*. It is plain that the test is of a totally different character from the third. No longer is the objective to establish reliability of a complete rocket. The interest has switched to a newly introduced lower stage or stages. After the tone of finality in the third communique a development of this sort was to be expected. We are encouraged to interpret the reference to a "carrier-rocket of a new type," which at first sight was not necessarily significant, as meaning a rocket embodying a new advance in technology or size compared with that tested in the first three launches. The complete rocket will probably have four stages.

The fifth launch communique leaves us to assume that this launch involved a similar rocket to launch four, because it again refers to a model of the penultimate stage, as do all subsequent communiques. Significantly, it also announced that the period for launches is extended from October 15 to October 30. "In connection with the broadening of the programme of scientific investigations for the further conquest of space, Tass is empowered to state that launches of carrier-rockets into the region of the central part of the Pacific Ocean, designated in the Tass communique of September 11, 1961, will be continued to October 30, 1961."

Had the Russians come up against an unexpected difficulty, or unexpected success?

It seems the latter. Unexpected difficulty would surely lead to a



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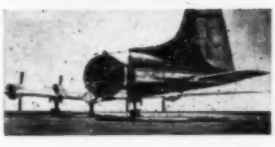
AIR CARGO SPECIALISTS* PLAN NEW FREIGHT SERVICES WITH SWING-TAIL FORTY FOUR

In the light of current developments in Air Cargo, we challenge you to consider this statement: the time has come to make a searching reappraisal of air freight operations if they are being conducted with obsolete piston-powered passenger aircraft that have been converted for cargo use. We are convinced that these aircraft, although they may still represent a multi-million dollar book investment, should now be disposed of, notwithstanding current market prices, and replaced by the modern all-cargo Canadair Forty Four.

ARE YOU READY



Inevitably, the disposal will result in a "profitable loss," because it can be shown that the Forty Four is the only all-cargo aircraft able to operate at a profit, either domestically or internationally, under the new low freight rates. In a short period of time, the losses incurred on the sale of the outmoded converted equipment will be recovered by the swing-tail Forty Four. Any General Dynamics or Canadair official would welcome the opportunity to discuss this in more detail.

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Missiles and Spaceflight . . .

more lengthy interval before the next launch. But launch six follows launch five in only three days—the shortest interval of all. And into the extra 15 days go two more launches, at seven-day and six-day intervals respectively. It seems that a programme originally planned for six launches was extended to eight. The Russians found it possible to go ahead further than originally planned. The communiqué for launches six and seven are very short, adding little. The last communique, following launch eight, sums up the series:—

"On October 28 of this year in the Soviet Union was carried out the scheduled launch of a multi-stage carrier-rocket into the region of the central part of the Pacific Ocean over a distance greater than 12,000km.

"The flight of the rocket took place in strict correspondence with the set programme.

"The model of the penultimate stage reached the water surface with high accuracy relative to the calculated point of impact.

"With this launch the intended programme of scientific research is successfully completed.

"In the process of conducting launches of carrier-rockets valuable scientific facts have been obtained, essential for the further conquest of space.

"The launches of multi-stage carrier-rockets with high accuracy over great distances bear witness to new major successes of Soviet rocket construction."

How does this series relate to the Russian space programme? Some deductions are clear. Since January 1960 the Russians have been following a course designed to achieve and medically investigate manned flight in orbit—Phase 2 of their programme, according to the analysis given in *Flight*, August 17, pages 230-1. The direction of this phase has been so unmistakable that the next step seems certain to be a close-orbital flight in a Vostok lasting from three to seven or more days. This will require virtually the same rocketry as previous Vostok launches.

But we have the plainest evidence, in the first three launches of the recent series, that the Russians are ready to do something which will require an advance in rocketry. Perhaps the phase of close-orbital Vostok flights is already over. Perhaps there will be one more launch only. Phase 3 seems closer than anticipated. It may begin with the introduction of a heavier spaceship-satellite capable of significant changes of orbit; or with the injection of a Vostok into a fairly elongated ellipse, with subsequent re-entry at near-parabolic velocity.

So much for the meaning of the first three tests. In the second group of five there is little doubt that we see early trials of a rocket the Soviet Union plans to use in a still later phase of her programme. With five successes achieved in a series of firings following each other so rapidly that any abortive launch would surely have created an obvious gap, the rocket has made astonishing progress.

The final importance of the tests is that they throw new light on the development of Russian rocketry. The tests of January 1960 introduced the Vostok rocket, which orbited the first spaceship-satellite the following May. All spaceship-satellites have weighed about 10,000lb. But Soviet spokesmen, Maj Gagarin among them, have repeatedly said that the rocket could orbit payloads many times greater. This seems logical for independent reasons (we might expect up to, say, 40,000lb). The later tests in July 1960 and the first three launches of the recent series appear to represent preparation of the rocket for such heavier payloads. The July 1960 tests may in particular relate to the 14,295lb Sputnik 7 and the Venus probe. In view of these considerations the last five launches of the recent series show up even more plainly as trials of a basically new rocket.

We can now formulate the progress of Russian launching vehicles as follows:—

First:	For Sputniks 1, 2 and 3	Oct 57-May 58	Original ICBM (probably two stages)
Second:	For Luniks 1, 2 and 3	Jan 59-Oct 59	Original ICBM plus extra boost and new final stage (probably three stages in all)
Third:	For spaceship-sats, Sputnik 7, Venus probe	May 60-present	Vostok rocket, tested Jan 60 (probably three or four stages, with same final stage as Luniks)
Fourth:	For advanced space exploration	Introduction probably 1963	Trials Oct 61

We are familiar with the performance of the first and second vehicles. There is some information about the third, from which we can make a guess about the fourth. The next Soviet experiment, other than a close-orbital Vostok launch, should go far to clarify our concept of the key third vehicle. TONY DEVEREUX

TRANSIT SUCCESS

A successful double launch of the US Navy's Transit 4B and TRAAC (Transit research and attitude control) satellites was made by Thor-AbleStar vehicle from Cape Canaveral on November 15. Each satellite weighs approximately 200lb, and both were placed in similar 528-582 mile orbits with an orbital period of 105.8min.

Transit 4B was stated to be the last of the present series in the Navy's experimental navigation satellite system tests. If its navigation signals prove accurate enough, it may be used as the first satellite in a four-satellite system which the Navy hopes to have working by late next year to give navigational fixes to ships anywhere in the world. It carries an atomic generator to power two of its four transmitters.

The piggyback satellite TRAAC was designed to check the feasibility of using the Earth's gravitational field to keep the satellite permanently stabilized with one side directed towards the Earth. Approximately two weeks after launch the attitude-control experiment will begin, using an extending 100ft copper-tube aerial.

RANGER FAILURE

The National Aeronautics and Space Administration's postponed attempt to launch the Ranger 2 spacecraft into a 500,000-mile trajectory, by Atlas-Agena B rocket from Cape Canaveral, was unsuccessful on November 18, when the spacecraft failed to separate from the Agena second stage in orbit at 94-145 miles.

This was the second failure in the Ranger series, although the Ranger 1 launch of August 23, 1961 did obtain a certain amount of useful data. On this occasion the craft was placed in a low Earth orbit—105-313 miles—instead of the highly eccentric orbit planned.

Both Rangers were designed to develop and test basic spacecraft technology required for lunar and planetary missions, and to carry a number of important scientific experiments.

DISCOVERER SUCCESS

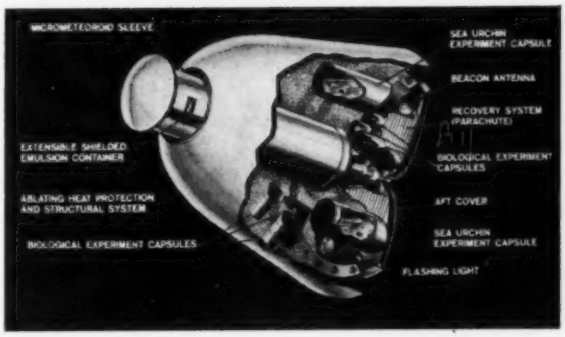
The experimental capsule of the USAF's Discoverer 35 satellite, launched from Vandenberg Air Force Base by Thor Agena B on November 15, was recovered in mid-air some 650 miles west of Hawaii two days later. The payload included human and animal tissues and cells, and samples of silicone, bizmuth, iron, lead, magnesium, nickel and titanium, in an investigation of radiation effects in space. This was the tenth successful capsule recovery in the Discoverer series, and the seventh successful mid-air capsule recovery.

NASA's Bios (Biological Investigations of Space) experiment suffered two failures last week. On November 15 a malfunction in the Argo D-8 vehicle caused an abortive launch; while on November 18 the back-up vehicle apparently achieved the planned height (1,165 miles) but the recovery capsule descended by parachute "off course" into the sea and was lost.

Dr Eugen Saenger, the West German rocket specialist, is reported to have resigned in order to accept a post with the Egyptian Government.

According to unofficial reports from Moscow, the Soviet Union is planning to launch a manned spacecraft on a lunar orbital mission early next year, probably from the Vostok launch site at Baikonur.

Re-entry and recovery capsule of the ingenious but (on Nov 15 and 18) unsuccessful Bios I (Biological Investigations of Space) experiment. Argo D-8 solid-propellant rockets were used in the launch attempts from Point Arguello, California. Details of the experiment were given last week



Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Monospar Memories

THE article *Vintage Twin* in your issue of October 12 was most interesting and Mr Cazalet's letter (Correspondence, November 9) prompts me to amplify your editorial comment. In June 1933, I was employed by General Aircraft Ltd at their Croydon factory as what the Croydon Employment Exchange subsequently described as an "improver aircraft bodywork assembler," and am fairly certain to have riveted up either the tailplane or the inner wing folding trailing edge assemblies of G-ACHU, which, as he says, was an ST.4.

In June and July 1933, the first ST.6 (G-ACGI), with retractable undercarriage, was being prepared for the King's Cup Race, but great difficulty was experienced with the redesigned cowlings for the Pobjoy engines, which persistently overheated. It was possibly because of the prevailing panic at that time that delivery of G-ACHU was made from Hanworth instead of Croydon, but I do not think the new Feltham works started production until the early months of 1934. In September 1933 all but a few of the Croydon employees were laid off and I do not think the others moved to Feltham much before Christmas. I remember an extra ST.6 landing gear being made for an ST.4 but did not see it installed.

I may mention that Capt J. W. G. James (who I see is mentioned in Dennis Powell's letter on the same page) had then just joined Imperial Airways as a pilot on probation and I used to see him accompanying Capt O. P. Jones up the long ladder to the cockpit of *Helena* and other Handley Page 42s operating the evening services to Paris during the summer of 1933. The late Keith Seth-Smith, Hawker's test pilot, was then an apprentice at General Aircraft also. No doubt Mr F. F. Crocombe or Prof S. C. Redshaw, who for a time comprised the sole design staff at Croydon under Mr Stieger, could confirm the date of transfer from Croydon to Feltham.

Bristol — SENRAB

Coventry's Airport

I HAVE noted, from recent issues of *Flight*, the increases recorded in traffic at various smaller airports, such as Portsmouth and Luton. However, I would like to point out that no mention has been made of Coventry Airport, whose traffic has increased by over 400 per cent this year, to approximately 5,000 passengers. These have been carried in Jersey Airlines' Dakmasters and Heron, Air Safari's Hermes and Vikings, Trans-European Airways' Rapides and Bristol Wayfarers, and Executive Air Transport's Dakotas.

I would just like to mention, as a closing note, that there are eight ex-Overseas Aviation North Stars awaiting sale at Coventry Airport.

Coventry — J. A. REEVE

[*Flight* looks forward to chronicling the continuing traffic growth at Coventry Airport and congratulates the airport manager and the Coventry City Council on their enterprise in issuing an attractive and informative pamphlet, a copy of which our correspondent encloses.—Ed.]

Supersonic Rat-Race?

AS a technician in an aircraft design office, I have taken more than a layman's interest in recent pronouncements about the proposed supersonic transport aircraft, and I find myself immensely saddened by the prospect.

My concern is increased on two counts: firstly, the unwarranted intrusion threatened into the privacy and well-being of millions of people who have no stake in the operation, and secondly, the immense cost of what will be primarily an international status symbol.

The gain to be expected in reduction of overall journey time will be small, even on a transatlantic flight, and the gain to be expected from cruising at M3 in preference to M2 seems ludicrously minute.

Journey cost to each passenger we can expect to be some 20 per cent higher than that by present-day transports. The supersonic transport will *not* open up new markets; it will provide marginally increased convenience to the usual run of politicians, film-stars and expense-account businessmen.

For the sake of pandering to the delusions of grandeur of these people, the general public is expected to endure the disturbance of unexpected thunderclaps by day and night, spreading in a band some 60 to 80 miles wide under the track of the aircraft. Already, in the best Orwellian manner, a start is being made on educating the populace to accept these unwarranted disturbances as a normal part of their lives.

Many advocates assure us that all supersonic flying will be carried out over water. But it has also been stated by an eminent authority that "it would be literally impossible to assume that one could live in an area that at some future date will not be saturated with sonic booms" (J. C. Floyd, *Journal of the Royal Aeronautical Society*, September 1961, page 621). One can well foresee how this will occur. At the start overland flights will be tried. Public clamour will demand that they be confined to overwater routes only; but soon the airlines, saddled with immensely costly machines, will protest that they are being crippled by this restriction, and the power of big business will prevail over the interests of the general population.

As a parallel, one can quote the example of the operation of the big jets at London Airport. At first, to mollify the local inhabitants, movements were not allowed during the night, but now they take place throughout the 24 hours, with no consideration for the neighbours.

The problem we are now facing will not be confined to an area around an airport. It is likely to be nation-wide, and if I seem to be exaggerating the problem, remember the disturbance that was caused one night some years ago over a large area of north London when a Victor [actually a Javelin, we believe—Ed] exceeded M1. By the standards we are now considering, that aircraft was very slow. In the paper already quoted, Mr Floyd states: "The human ear responds to the sudden pressure-rise in much the same manner as it would respond to thunder, except that the boom from an aircraft is of sharper intensity. Therefore, the shock effects would be more marked; and, while lightning usually precedes thunder and prepares the victim, no warning is available for the sonic boom."

We are in danger of committing our industry to squandering wealth on a project about as useful as the Pyramids, but not nearly so durable. It has been stated that if the industry is to survive it must develop the supersonic airliner. With that I cannot agree; but if it were true, surely it would be in the national interest to divert the skill and brain-power tied up in the industry into more useful and worthy channels. It would be tragic to allow such a large portion of the nation's valuable talents to be engaged in an occupation of less value to humanity than the manufacture of cosmetics.

The airlines are not really anxious to start operating these machines. They are all nervously eyeing their rivals, unwilling participants in a rat-race which makes them discard good equipment before it is paid for.

There is obviously a case here requiring early action. The Government should declare unequivocally that no supersonic flights shall take place over this country, save from the direst military necessity; and airlines which flout this ruling, or attempt to have it altered for their own commercial benefit, will have only themselves to blame when they burn their fingers.

Birmingham — PHUGOID

Dakota G-AGKF

IN reply to Mr Dennis M. Powell's request for information on BOAC Dakota G-AGKF (Correspondence, November 9), this aircraft was sold in June 1949 to SCA Air Nolis as F-BEFQ and written-off in a crash during May 1950.

Odiham, Hants. — G. J. CRUIKSHANK

FORTHCOMING EVENTS

Nov 24 RAeS Graduates' and Students' Section: Winter Dance.
Nov 27 RAeS Historical Group: "The Society's Library and Aeronautical History," by F. H. Smith.
Nov 29 Institute of Transport (West Middlesex Group): "A Pilot's View of Air Transport," by Capt O. P. Jones.
Nov 29 Society of Environmental Engineers: "The Response of Dynamic Systems to Shock Excitation," by B. H. Venning.
Nov 30 Guild of Air Pilots and Air Navigators: Professional Licence Holders Meeting: Annual Service and a.g.m.
Dec 1 RAeS Rotorcraft Section: All-day Meeting.
Dec 2 British Interplanetary Society: "International Law Extra-terrestrially Applied," by Bin Cheng.
Dec 6 BritIRE (West Midland Section): Conference on "New Electronic Techniques in Non-destructive Testing."
Dec 12 RAeS Astronautics and Guided Flight Section: "Military Requirements of Guided Missiles," by Brig E. W. Denison.
Dec 13 RAeS (Main lecture at Manchester Branch): "Airlines' Approach to Aircraft Selection," by M. Nivet.
Dec 13 RAeS Agricultural Aviation Group: Symposium on "The Uses of the Aeroplane in Agriculture."
Dec 13 Royal United Service Institution: "Some Reflections on the Strategic Air Offensive, 1939-45," by Dr Noble Frankland.
Dec 14 British Interplanetary Society: Symposium on "Auxiliary Power Generation."
Dec 15 RAeS Man-powered Aircraft Group: "Problems of a Man-powered Rotorcraft," by R. A. Graves.
Dec 17 Institute of the Aeronautical Sciences: Wright Brothers Lecture, Washington DC.

RAeS Branch Fixtures (to Nov 30): Nov 29, *Weybridge*, The R.K. Pierson Memorial Lecture, given by Air Marshal Sir Geoffrey Tuttle.

Straight and Level

I DO admire foreigners for their tolerance of British weights and measures. Bravely they try to play along with our illogical systems. My heart goes out in particular to the Frenchman who filled in our questionnaire for this special issue of *Flight* about the Sud-Aviation Caravelle. He entered the wing span of this aircraft as 112ft 6⅜in, and length as 105ft ⅛in.

Perhaps it was just a French joke, in the same high class as the announcement in *Les Ailes* a few months ago that BEA had decided to order Caravelles instead of Tridents.

For how much longer our friends in France, Germany, Holland, Belgium, etc, etc, are going to tolerate our system, let alone pull our legs about it, is a matter that should be weighing heavily, in kg, on British—and American—minds.

Anyway, thank you Sud-Aviation for a very complete reply to our questionnaires. It was one of the best replies of the lot. The other good ones—as last year—were those from the British Aircraft Corporation and from The Nihon Aeroplane Manufacturing Co of Japan.

Air Transport News

News-agency messages on my desk this week include the following:

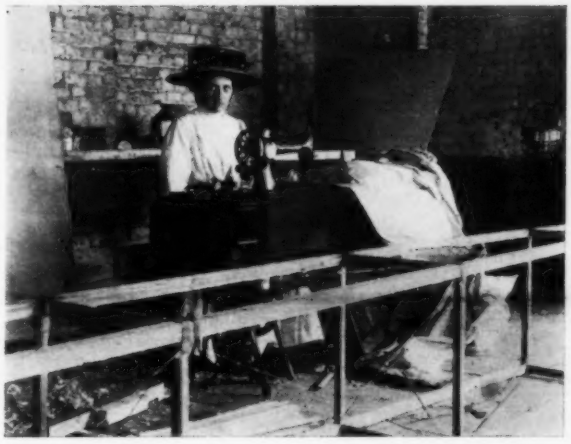
Washington. Capt Edward Bech told, an American airline pilot, said recently that it was about time "we stopped asking pilots to appease the public." He was referring to procedures designed to reduce noise, some of which "skirted the borderline of potential danger." Since then his phone hasn't stopped ringing. "We finally had to take it off the hook," he said. "I have never heard such abusive and filthy language."

Suva, Fiji. An airliner had to swerve when attempting to land at the Nadi International Airport, Suva, because a youth was asleep on the main runway. He told Suva magistrates that he was drunk and wanted to sleep it off.

Washington. In future passengers who may just look drunk will not be allowed to board American airliners.

Moscow. An Aeroflot pilot, Igor Bakhshumyan, has been awarded the Order of the Red Banner for courage and valour in preventing an attempt to hi-jack his aircraft. When three passengers demanded that he alter his course for Persia he refused and was stabbed several times. However, he managed to radio his base and make a forced landing, during which he was injured.

I remarked the other week on the importance of sorting the apocrypha of British aviation from the facts. One of the most charming stories I have heard repeated over the years is how Sir Geoffrey de Havilland's first wife Louie sewed the covering for the first D.H. aeroplane (1909). I always wanted to believe it, and now I can—with the publication, in Sir Geoffrey de Havilland's new book, of the delightful photograph I reproduce here*



● Into sleepy Popcorn, Nebraska (pop. 832) last week blazed a man with a mission—tough, bluff, gruff Sir James Mildew, boss of the Interline Air Travel Association which masterminds 184 of the world's most important airlines. Grated jet chief Mildew:

"I've been talking with the British Minister of Airports, Fred Quagmire, about his latest 66⅔ per cent increase in landing fees. I said anyone could see this was a damfool measure, businesswise. He snapped back: 'Get the hell outta here. Do you think we want a lot of lousy limeys busting up our racket?' "

Quipped air chief Mildew: "I predicate as of now that Quagmire will be kicked upstairs, as they say, to Britain's aristocratic House of Lords. Promotionwise, he's had it."

● Jimmy Dell has told a colleague what happened when he took a Lightning to the Paris Show. After Warton had telephoned Paris and Dell had filed a flight plan, he took off and started calling Le Bourget as soon as he crossed the south coast. Although he had all the frequencies, and used them, there was no answer.

Eventually Le Bourget approach came up, but did not seem to know who he was. They said: "Stand by, Monsieur." Then they asked him to orbit for 45min. Eventually, with only 10min fuel left, he had to say that either they received him or he went back to the UK. Whereupon he was courteously wished "bon voyage."

He landed at Boscombe and from there phoned Le Bourget, who politely explained that they had had a 45min stack of civil aircraft. They added: "It is a pity you are not still standing by as there is a gap in 15min."

Dell dashed out, took off, whipped across Northern France at M1.4 at 36,000ft, and 14min later was over Le Bourget.

Again no answer to his calls. He decided to make his own letdown. On finals, Le Bourget came up loud and clear, and as he taxied round the perimeter track after landing hailed "the latest British supersonic fighter." Surely *les mots justes*.

● I regard Air Cdre Banks as one of British aviation's more valuable assets, and his Sir George Cayley Memorial Lecture on aero-engine development was a master's memory-sketch of his subject. But I challenge him, from a respectful distance, on one point. He says of the Rolls-Royce Condor: "Though fitted in one or two military aircraft, it was not eventually made in quantity."

Now I know that the Condor was not one of Rolls-Royce's best efforts, but I can think of at least sixteen types of aircraft that had it (not including variants); and, of course, there were several squadrons of Condor-powered Horsleys in the RAF.

I suppose if I keep on challenging the pundits like this there will soon be a Roger Bacon Memorial Lecture.

● At the end of his recent Henry Royce Memorial Lecture Mr Peter Masefield lightheartedly displayed, to illustrate the future of British aviation, a picture of a sunrise. The discussion opened with the question: Are you sure it isn't a sunset?

Mr Masefield was quite sure. He had taken the picture himself, and it was *definitely* a sunrise.

ROGER BACON

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* "*Sky Fever: The Autobiography of Sir Geoffrey de Havilland.*" *Hamish Hamilton, 25s.*

Four Convair 240s are operated by North Japan Airlines of Hokkaido, who operate domestic services which include Tokyo, where this picture was taken

AIR COMMERCE

SUPERSONIC ENTENTE?

ALTHOUGH no official comment is forthcoming, it is believed that a *Guardian* report last week, to the effect that Sud-Aviation will assume design leadership of a joint Anglo-French supersonic airliner project, is substantially correct. The air correspondent of the newspaper says that the British design for a six-engined long-haul M2.2 airliner "is now almost certain to be dropped" and that two versions of the four-engined Sud design will be developed instead. According to the report, design leadership will go to Sud under M Pierre Sartre.

It appears certain that no actual decision has yet been taken by Mr Peter Thorneycroft, Minister of Aviation. Any such decision would obviously be a political one, paving the way for a cementing of a close technical working association that has existed between BAC and Sud for some considerable time past. While both the British and the French obviously recognize the advantages of a joint supersonic airliner programme, the most delicate of all the issues involved—and one which may well require a solution on a political level—is the matter of design leadership. If *The Guardian* report proves to be correct, French design leadership of an Anglo-French supersonic airliner will represent a major change in British policy. As the newspaper puts it: "the British Government has been anxious to improve its European image; and Mr Thorneycroft has found an apparently happy political and economic solution in proposing that his two expensive children, space and supersonic airliners, should be the first offspring of the intended marriage."

Discussions between the French and British Governments and manufacturers are at an early stage, and any joint project would still be very much concerned with "feasibility." Both BAC and Sud have been working on feasibility studies for their respective governments for the past year or so. Both studies have in common the M2.2 design parameter; but whereas the French design (typified by the Super Caravelle project, of which a model was shown at the Paris Salon last May) is a four-engined machine for medium ranges, the British design (which began as the Bristol 198 under Dr Russell, and which has become the BAC-198) is a six-engined project for North Atlantic operations. It seems logical to attempt to apply one basic airframe and propulsion system to both requirements.

It is likely that a joint project will be British-powered, either by Bristol Siddeley—with an advanced Olympus—or by Rolls-Royce. If the Bristol Siddeley engines are chosen, the propulsion system would move forward as a joint SNECMA/Bristol Siddeley effort, for the two firms have been partners since sleeve-valve days.

A vast amount of basic research and airframe development work has been done in both countries, and it is believed that a great deal of information has already been exchanged on a technical level. There appears to be no doubt in either the French or British industry that, notwithstanding the declared American intention to proceed with a Mach 3 airliner, Mach 2.2 is the logical and technically correct first step towards supersonic air transport.

Obviously, the immense cost of a supersonic airliner programme—anything between £100m-£200m for the production of a prototype—would be shared by the two countries.

LORD DOUGLAS ON EUROPEAN AIR TRANSPORT

IN the Royal Aeronautical Society's lecture theatre on Wednesday of last week, Lord Douglas of Kirtleside, chairman of BEA, examined at length *The Progress of European Air Transport 1946-61: with Particular Reference to BEA*. The occasion was the seventeenth British Commonwealth Lecture and Lord Douglas used it, as he said, "to take a few steps back and get a broader view of the developments of the post-war years." The following is a summary of his paper.

Europe [said Lord Douglas] has a prolific network of air services. Perhaps too prolific. The route network is now over 200,000 miles, but the backbone of the system is a network of 20 routes which, in 1960, carried one-third of all international air traffic in Europe. Two points stand out: over-water journeys still remain a very high proportion of total European air travel and the UK market is of major importance in the European pattern.

European traffic, which has increased by 800 per cent over the past 13 years, has grown much more than the world average of 475 per cent and very much more than the US domestic air traffic growth of 400 per cent. BEA's traffic, said Lord Douglas, had increased even more rapidly than the European average.

BEA holds predominant position in Europe; the other point to note is the rapid growth of traffic of Lufthansa and Alitalia in the past five years. It is this change in the balance of airline power in Europe which caused so much trouble in the Air Union and earlier Europair negotiations.

Two essential characteristics are short length of haul (average 425 miles by ARB members in 1960) and the degree of seasonal variation compared with that of domestic services in the United States and Australia.

European air traffic's favourable rate of expansion compared with other parts of the world can be explained by (1) reductions in the level of air fares, both in absolute terms and in relation to other prices (particularly surface fares); (2) increases in national income and its distribution; (3) improvements in the quality of air travel. Increase in leisure time, acceptance of air travel, population growth and an increasing trend towards living in cities, also affect the growth of air traffic.

The first three of these factors are the most important. Air fares in Europe have shown a steady downward trend in the past ten years. Relative to purchasing power and the prices of other goods and services, European airlines have reduced fares by 25 per cent in the past eight years. The difference in fare levels between the US and Europe is much less than is often suggested. And whereas the average level of air fares in the US has remained more or less at a constant level for the past few years, the European trend remains strongly downwards.

Fare reductions, said the lecturer, have been the most important influence on air traffic growth in Europe. The second factor has been the increase in incomes during this same period. More people would have been able to afford air travel even if air fares had not been reduced. As incomes increase, each group of consumers tends to have a larger percentage of income over and above the essential amounts which they are obliged to spend on food, housing, clothes, and fixed commitments. It is apparent that there is a clear preference for more travel as this "discretionary" income increases. The effect of these two aspects of income and expenditure distribution is that the demand for travel increases more rapidly than total national income.

The third factor which explains the rate of European air traffic growth is the improvements in the quality of air services; comfort, speed, frequency, regularity, punctuality, convenience, efficiency and safety. Improvements in the quality of European air transport have brought about a total transformation of air services in the post-war years.

Although there has been a revolutionary improvement in the operational nature of European air services in the past ten years, intra-European air services as a whole are not yet financially self-sufficient. Of the nine main airlines, six had unprofitable European operations, one broke even and only two—BEA was one of them—made profits in 1960. The average position was revenue fell four per cent short of expenditure.

It was his view, said Lord Douglas, that the primary reason for this state of affairs is the low load factor at which many European routes are operated. BEA's ability to operate profitably has not been due to a higher revenue rate (which was, in fact, four per cent below the European average); its better financial results are partly explained by its 7½ per cent lower than average unit cost level. But even more important is the fact that BEA's load factor of 68.4 per cent was eight points higher than the European average in 1960. Low load factors are the key to the financial problems of European operations. The three airlines shown in Fig. 2 as having the worst financial results were also the three which had the lowest load factors.

[*Continued on page 795*

The Westland range of turbine powered helicopters covers rotary wing aircraft from 5000 lb. to 58000 lb. which are capable of meeting all requirements in all parts of the World.

Advantages of turbine powered helicopters include improved overall operating economy, less noise and vibration and greatly improved performance in high temperatures and at high altitudes.

Westland were among the pioneers in the application of turbine power to the helicopter and already in this class they have in production the Wessex I, Wessex II, Gnome Whirlwind, Belvedere, and the Scout, whilst the development of the 60/65 seat Rotodyne vertical take-off airliner is actively progressing.

Westland Helicopters are in service with the following:—

Governments of Ceylon, Cuba, Egypt, Iran, Iraq, Kuwait, Hong Kong, France, Thailand, Yugoslavia, Japanese Security Forces, Brazilian Navy, Royal Jordanian Air Force, Ghana Air Force, Royal Navy, British Army, Royal Air Force.

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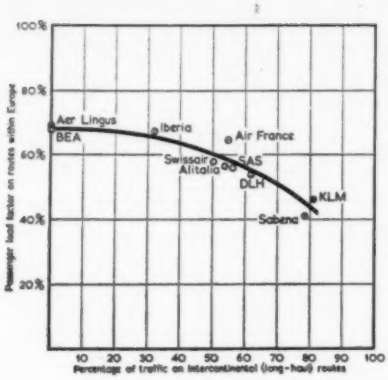
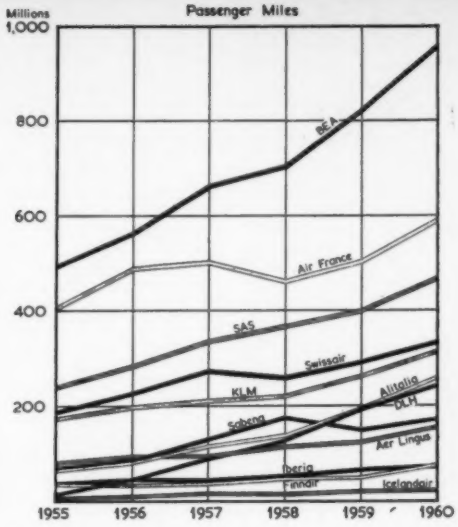
LIVES SAVED TO DATE BY MARTIN-BAKER EJECTION SEATS

M-B A

AIR COMMERCE...





Two illustrations from Lord Douglas's paper: left, correlation between percentage of traffic on intercontinental routes and European load factor, 1960. Right, intra-European passenger traffic by carrier, 1955-60

Why is the load factor of so many European airlines uneconomically low? The answer is (*a*) because the airlines concerned are looking at their European routes as feeder services for long haul traffic and (*b*) because they appear to base their economic outlook on spurious arguments about the marginal costs of operations. Fig. 3 supports these contentions; airlines which get the majority of their traffic from long haul operations are the ones which operate their European services at low load factors. The argument is that the marginal cost of operating an additional service will be more than covered if a few extra long haul passengers are attracted by that additional service. An extra service can then be justified at an extremely low load factor, thus reducing the average load factor. There are two possible fallacies inherent in this argument. The first is that some of the so called additional passengers may well have travelled anyway. The second is that the argument that additional costs specifically incurred as a result of operating a particular service are only a very small percentage of total airline costs is a short-term view. Men and materials can be redeployed to other activities. And the scope for such redeployment increases when we take a long term view in airline planning. Hence marginal costs tend to get closer to average costs the longer ahead we look.

Intergovernmental air agreements—bilaterals—have undoubtedly caused more frustration for airline managements than any other problem. Whatever we think about them these national policy factors are part of the facts of life of the air transport business. I can see no useful purpose in arguments, like those we heard recently before the Air Transport Licensing Board, which said in effect "Wouldn't it be nice for the airlines if the world were a different place."

It is the tacit adoption of a philosophy of minimizing the adverse effects of economic and political nationalism in air transport which explains the degree of co-operation which the airline industry has achieved. Then there is the general movement in Europe towards closer political and economic integration. These moves towards European integration may change the views of individual nations about protecting the interest of their own airlines. Another influence is that the whole airline industry throughout the world is faced by new problems caused by the jet revolution. As a consequence, economic pressures towards technical and commercial co-operation are particularly strong at the present time.

[To be concluded]

THE INDEPENDENTS DINE

USUALLY at the annual dinner of the British Independent Air Transport Association the traditional guest of honour, the Minister of Aviation, drops the first public hint about some major new policy. In 1959, Mr Sandys hinted at the desirability of independent mergers; the year before Mr Watkinson dropped a hint about the need for licensing. Last year Mr Thorneycroft made his famous remark about airports not being run "as a branch of the Welfare State"; this year he chose to say little—except, significantly, that the "future [of the independents] will lie with the strong." In the context in which he spoke this was taken to mean more mergers, though the manner in which these would be made, he told his hosts, "are for you to decide."

Mr Clive Hunting, president of BIATA, paid tribute to the Air Transport Licensing Board. Decisions not lightly taken had been arrived at—"not always as quickly as some of us might like, but at least with a forthright clarity that we all applaud . . . in all sincerity we say: You're all right, Jack." He agreed wholeheartedly that the board should consider the financial resources of applicants, but it would not be in our interests if this became a way of inadvertently letting in foreign competitors.

He felt he would be shirking his responsibility if he did not touch on the "difficult and delicate subject of safety and aircraft accidents." He thought that the three aircraft belonging to BIATA members that had suffered fatal crashes during the past three summers had not been an accident rate worse than the world average, but that was not good enough. He refuted categorically any implication that older aircraft were unsafe.

He could not rule out the possibility of further mergers among members of BIATA, nor could he rule out the possibility of some members finding it impossible to carry on. But it was surely healthy that new aggressive managements rose to take up the running and the weaker give up the race. He hoped that this would not be thought a ruthlessly unsentimental outlook. Air transport was a hard task-master, gobbling up capital in re-equipment programmes, and unforgiving of commercial mistakes.

Finally, Mr Hunting called for a closer co-operation between BIATA and the corporations. The time had come when it might be sensible to put existing experience of working together on to a more firm footing. He was not talking of anything like a Chamber of British Aviation, though he had little doubt that this would come (quicker than many realized); but "I believe it might commend itself to all parties if we were to meet at infrequent but regular intervals purely as airline operators so that we can then speak as one—perhaps even producing a united British front at IATA" [laughter].

He noted that for the first time the BIATA report included orders for jets and perhaps in the foreseeable future a BIATA president might draw attention to the first orders for supersonic transports. For his part that date could not come too slowly. Mr Hunting concluded with a tribute to the work of BIATA's secretary for the last ten years, Mr A. M. Blakemore, who has since taken up an appointment with British United Airways. His best wishes went to his successor, Mr Dick Cleaver.

This is a DC-4 of Syrian Arab Airways, the new government airline established in Damascus following the revocation, on October 16, of Syria's association with UAA. Also in the fleet are two DC-6s, another DC-4 and a DC-3

AIR COMMERCE...

CLEARING THE BAHAMAS AIR?

REPOSSESSION of Bahamas Airways by BOAC was "primarily a matter for BOAC's commercial judgment," and the Minister accepts the arguments put forward by BOAC in its annual report. He also "accepts . . . responsibility for the action taken." This was said in the Commons on November 13 by the Parliamentary Secretary to the Ministry of Aviation, Mr C. M. Woodhouse, in reply to a question by Mr John Rankin (Lab, Glasgow, Govan). Pressed further by Mr Rankin to say whether the Minister has "had for some time" a special report on this matter, and would he publish it, Mr Woodhouse replied: "All the necessary information has been published in BOAC's annual report."

In *Flight* for September 28, page 524, Mr Keith Granville, chairman of BOAC Associated Companies, said that a full report about Bahamas Airways was with the Minister. (This report, it is presumed, is one that was made for BOAC last summer by an independent commission comprising Sir Frederick Tymms and Mr Stephen Wheatcroft.) Mr Granville had been asked in a *Flight* interview by Mr Frank Beswick about the "extraordinary circumstances" in which Bahamas Airways had been sold by BOAC to private enterprise and then bought back again; would he state, he was asked, the net financial result of the two transactions? Mr Granville's reply was: "I am unable to give you the figures. A full report is now with the Minister." This statement is not contradicted by Mr Woodhouse in his reply to Mr Rankin: all that Mr Woodhouse is saying is that all the necessary information has been published.

Flight has been told by Mr Eric Rylands that he is concerned with what he says are inaccuracies in the article on Bahamas Airways by the Air Transport Editor which appeared in *Flight* for November 9. Mr Rylands says that the sale of an interest in Bahamas Airways to Mr David Brown and to himself, and its subsequent re-purchase by BOAC, was governed by the terms of an agreement completed at the time of the purchase, and therefore "certain comments" made by *Flight* cannot, he claims, be justified. Mr Rylands is, he says, preparing a statement of the facts governing his association with Bahamas Airways (which BOAC announced it was going to repossess in December 1960). He will be submitting this statement to the chairman of BOAC during the next week or so. As soon as the facts—which are presumably additional to those in the Tymms report—have been laid before Sir Matthew Slattery, Mr Rylands has promised to let *Flight* have a similar statement. In this he will, he says, correct the alleged *Flight* inaccuracies.

UAA's THIRD COMET ORDER

UNITED ARAB AIRLINES has confirmed an order for an additional two Comet 4Cs. This second repeat-order will bring its fleet to seven (see *Flight* last week). It is understood that the aircraft are already well advanced on the production line.

Meanwhile the Egyptian airline is still undecided about its choice of long-haul jet equipment, a choice which is believed to lie between the Boeing 707 and the Vickers VC10. The managing director, Mr Hassan Mahmud, has recently been in England for further talks with the British Aircraft Corporation.

No decision on a replacement for the Viscount, which UAA during last summer thought would be the D.H.126, has yet been made.

BILATERALS IN THE NEWS

BRITAIN'S bilateral air agreement negotiators, led by Mrs Allison Munro, have been unusually busy in recent weeks. The Minister of Aviation himself, Mr Peter Thorneycroft, joined the British delegation, led by Mrs Munro, which recently went to Montreal to talk about the implications of CPAL's claim for a Vancouver - London service. And the Turks, for the first time, are being openly fractious about their air agreements, not only with Britain but with other countries also; Mr Michael Custance, deputy secretary to the Ministry of Aviation, has recently been in Italy to pour oil on long-troubled Anglo-Italian bilateral waters; and the legal tussle between BOAC (and other European North Atlantic carriers) and the CAB, who are calling for fifth-freedom traffic statistics, continues. Two other bilaterals, one with the Swiss and the other with the Philippines, have been the subject of peacefully concluded negotiations.

First, the Anglo-Canadian agreement. As already reported, the Canadian Government recently designated CPAL for its long-sought route from Vancouver to London *via* Edmonton and Calgary, but the British Government did not approve. As Mr Peter Thorneycroft said in Montreal, the issue involves the question of whether the North Atlantic can support more than two carriers and, if so, whether there should be three or four carriers. He had no complaint about the Canadian designation of CPAL although he pointed out that the inclusion of Calgary on the route was outside the terms of the existing air agreement. Mr Thorneycroft said that the Anglo-Canadian air agreement will be re-opened at talks in London early next year, and that this could lead to a general revision "aimed at providing a more balanced arrangement for Canadian and British airlines." It will be recalled that the Air Transport Licensing Board refused Cunard Eagle's application to operate between the UK and Canada on the grounds, fundamentally, that it would upset the existing BOAC/TCA pool agreement. Obviously the addition of two more carriers to the UK - Canada route would provide additional capacity that would have to be carefully regulated if it is not to prejudice the BOAC/TCA operation.

The Turkish Government, concerned about the financial situation of THY, has been threatening to reduce BOAC frequencies on the Istanbul - Frankfurt route and is also said to have asked BEA to change schedules which conflict with those of THY. Other carriers whose rights in Ankara or Istanbul have been similarly threatened are MEA and Pan American.

Negotiations in Rome with the Italians about BOAC and BEA capacities and frequencies, which Alitalia have long felt is disproportionate to their "quota," have resulted in additional fifth-freedom rights for Alitalia out of London for one flight a day to any US terminal (not only New York, as at present), increasing to nine flights a week by 1964. Alitalia also gets traffic rights for three flights a week Hong Kong - Tokyo and two flights a week Singapore - Sydney.

A Philippine delegation led by HE the Hon Leon Ma. Guerrero, Philippine Ambassador, and a UK delegation led by Mr G. McD. Wilson of the MoA have met in London and "satisfactorily" concluded arrangements about the current and future pattern of air services between the two countries, as laid down in 1955.

Finally, as already reported, the Swiss Government has granted Channel Air Bridge traffic rights in Basle and Geneva for the new car ferry services due to start next April. Up to eight services a week to Switzerland are provided for, with passengers supplementary to car passengers limited to eight per single flight. French intransigence over Channel Air Bridge's wish to operate vehicle ferry services to Strasbourg appears to have mellowed as a result.

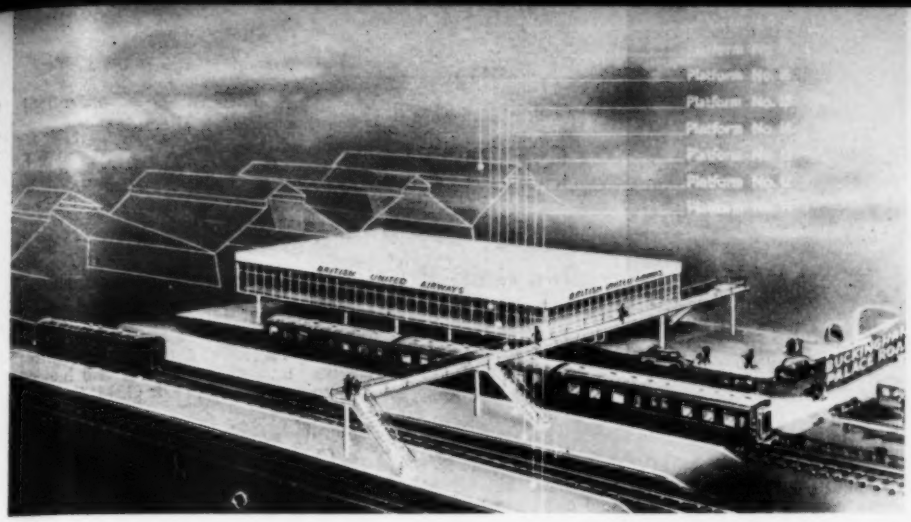
BEA WILL NOT OPPOSE BOAC

LAST Tuesday, November 21, the ATLB was due to open its hearings into British United and BOAC applications for new African routes. The hearings were due to continue yesterday and today and are likely to be resumed on November 28, 29 and 30.

In the list of objectors to BOAC applications appeared BEA—apparently the first clash between the two corporations. But BEA will not now in fact be objecting to the BOAC applications, which are for new routes to the Congo and for additional stops to the Congo on existing African routes to South and West Africa. The grounds of BEA's initial concern, which led to their appearing as an objector, arose from the inclusion by BOAC of Brussels as an optional stop, the London - Brussels route not being one of those included in the BOAC-BEA pool agreement concluded two or three years ago covering parallel European sectors. It is understood that the problem was resolved before the hearing, presumably by inclusion of London - Brussels in the agreement.

British United Airways are applying for points in the Congo on the London - Johannesburg service, to which BOAC are objecting. BUA is also stating its case for a London - Lagos service *via* Gibraltar, Las Palmas (or Tenerife) and Freetown, and for a London - Mauritius service *via* Entebbe or Nairobi, to which BOAC are also objecting. There is another independent application, from Starways, for a service from Glasgow to Lagos *via* Liverpool, Manchester, Gibraltar, Bathurst and Freetown.

BEA has been awarded the US Flight Safety Foundation's bronze plaque, sponsored by "Aviation Week," for its air safety work. It is the first airline outside the USA to have been so honoured



Work started on November 13 on British United's new £100,000 terminal to be built over the platforms at Victoria Station, London. Mr W. T. Fearne, Victoria's station master, and Mr F. A. Laker, British United's executive director (right), are seen, suitably attired, at the inaugural ceremony. Target date for completion is May 1962

END OF THE SUSPENSE?

TODAY, November 23, it is expected that the Air Transport Licensing Board will publish its decisions on the big European-routes case heard between June 20 and August 2. It is thought likely that the decisions, and the Board's reasons for them, will be published in the form of a lengthy document, and that the parties concerned will have about 24 hours' notice of the fate of their applications and objections.

There were about 70 applications, 50 or so for international services and the rest for UK domestic routes, and nearly all the routes involved were BEA routes. The one million words or so of evidence were summarized in *Flight* for June 29, July 6, 13, 20, 27, August 3, 10, 17 and 24 ("Public Meeting 21").

The two main applicants, of course, were British United Airways and Cunard Eagle Airways, and the main objector was British European Airways. At the time of going to press there was no hint of any kind as to the Board's decisions. The case is without question the most momentous yet heard by the Board.

The issues are not nearly so straightforward as those in respect of the Cunard Eagle North Atlantic case, on which the Board made its decision with remarkable speed—actually within 23 days of the hearing. It has taken the Board 113 days to make up its mind as to how it will dispose of the application in this major test case. Its deliberations have not been lightened by a very heavy workload of inclusive-tour applications; and of course quite a lot of its time has been wasted by the financial demise or difficulties of two other applicants, Overseas Aviation (C.I.), Ltd, and Tradair.

Such rejoicings or lamentations as the Board's decisions may evoke may be premature, since every thwarted applicant or objector has the right of appeal to the Minister within 21 days. There almost certainly will be appeals, and these could prolong the suspense for several more months. Although the BOAC appeal against the Cunard Eagle North Atlantic licence was heard on September 26, the appeal commissioner's recommendation has not yet been published, though it is believed to have been in the Minister's hands now for at least a month.

ARGOSY HISTORY

REVENUE from public transport operations was earned by the Argosy for the first time last Friday, November 17. On that day BEA's first aircraft (G-APRM), which has been engaged on crew training, was chartered at short notice by a Leicester manufacturer of shoe-making equipment, who had a bulky 6½-ton consignment of machinery to send to Paris.

The aircraft was positioned at Manchester on the Thursday, the Rolamat equipment set up during the previous night, and the Argosy took off for Paris at 1.58 p.m.

First revenue-earning service by the Argosy was on January 15, 1961, by one of Riddle's aircraft on USAF "Logair" operations.

BREVITIES

A Bristol Britannia 318 has been acquired by the Czech airline CSA from Cubana.

A receiver has been appointed by the debenture holders of Air Safaris Ltd and has taken over the management of the Gatwick based company.

Mr B. H. Theunissen, BOAC's station manager in Johannesburg since 1950, died suddenly at his home on November 13.

PIA has entered into an agreement with Pan American and New York Airways for "a helicopter feasibility survey" in East Pakistan.

According to the Japanese magazine *Aireview*, All Nippon Airways has decided to adopt either the D.H.121 Trident or the Boeing 727 for domestic jet services.

Continental Airlines' Boeing 707 N-70773 has now flown more than 10,000hr, the first jet airliner of any make to do so. Since delivery in April 1959 the aircraft has averaged more than 10.82hr per day.

IATA has stated its requirements for meteorology in a document published under the title *Requirements for Meteorological Service for International Air Transport Operations*, published free of charge by IATA, 1060 University Street, Montreal 3, Canada.

A TWA Boeing 720 suffered failure of No 1 engine in flight at 25,000ft on a flight from Los Angeles to Boston on November 5. Parts of the engine struck the wing and penetrated the cabin, causing loss of pressurization. The emergency oxygen system operated, there were no injuries and the aircraft landed safely.

The 12-day official strike of 1,000 Ministry of Aviation loaders and porters at London Airport ended on November 17, and is estimated to have cost BEA (who were not a party to the dispute) some £240,000. The strike was over an extra 2½d an hour "responsibility allowance" for loading baggage without supervision. The strikers won their claim.

KLM reports a loss during the first nine months of 1961 of £4.14m.

The Civil Aviation (Eurocontrol) Bill was presented for its second reading in the Commons on November 17.

SAA has dismissed the two pilots of the Boeing 707 which suffered damage on take-off from Athens on August 2.

The Minister of Aviation has granted provisional planning permission for the conversion of Castle Donington airfield, ex-RAF, to a new civil airport for the Midlands.

Air Ceylon is looking for a good second-hand DC-6B, completely reconditioned and equipped with modern aids including radar, for regional services between Colombo, Bombay, Karachi and Rangoon.

Although TCA has been expected to purchase Canadair CL-44s for all-freight work, the airline is now said to be considering the purchase of seven DC-8F Jet Traders.

The FAA Statistical Handbook of Aviation, giving a complete review of US civil aviation in 1960, has been published by the US Government Printing Office, Washington 25, DC, price 65 cents.

BKS has withdrawn its twice-weekly Leeds - Rotterdam - Düsseldorf service which, according to a spokesman, was "proving uneconomic." It is reported that the airline is now planning to introduce its Avro 748s into service on April 15, 1962.

Continuing the regular Anglo-US exchanges of information, a party of Ministry of Aviation officials led by the Minister, Mr Peter Thorneycroft, has been in the USA for three days discussing "common civil aviation problems." Accompanying the Minister were Mr J. M. Wilson and Mr D. W. G. L. Haviland, Deputy Secretaries; AVM Sir Laurence Sinclair, Controller of Ground Services; Mr Morien B. Morgan, Deputy Controller, Aircraft Research and Development; and Gp Capt J. B. Veal, Director-General of Navigational Services.

SERVICE AVIATION

Air Force, Naval and Army Flying News

First nonstop UK-Australia flight, by Vulcan of 617 Sqn: Sir Harry Broadhurst, Avro managing director, presenting trophy to Wg Cdr Bastard

New AMP

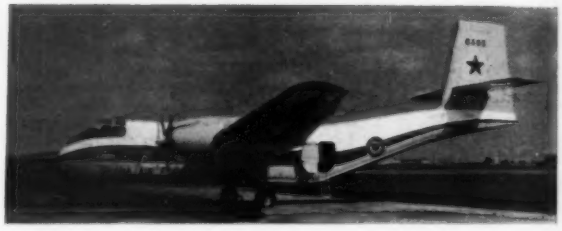
A CHANGE in the Air Council has been announced: Air Marshal Sir Walter Cheshire, KCB, CBE, is to become Air Member for Personnel from December 11 in succession to Air Marshal Sir Arthur McDonald, KCB, AFC, who is relinquishing his appointment for health reasons. Air Marshal Cheshire has been AOC Malta and Deputy C-in-C (Air), Allied Forces Mediterranean, since May 1959. Air Marshal McDonald became AMP at the beginning of October 1959.

"Sky Help" Statistics

WITH a reduction in the immediate need for an airlift of stores and troop reinforcements to Belize in British Honduras, the part played by the RAF—known as Operation "Sky Help"—is being diminished. The daily commitment amounts now to two sorties by Shackletons and Hastings between Palisadoes Airport at Kingston in Jamaica (where 38 Group of Transport Command set up an air transport operation centre) and Belize.

Shackletons, Hastings and Britannias have since November 1 been actively engaged in flying freight, medical supplies, stores and passengers from the UK to Kingston and between Kingston and Belize. In addition to these aircraft, the Air Ministry chartered some civil machines to assist in the airlift.

The last aircraft, which left the UK last Thursday, brought the total load flown to Kingston to 293,000lb and 750 passengers. Nearly 30 sorties were made between Kingston and Belize and despite bad weather early in the operations and restrictions at Belize airport, all flights were successful. On their return flights to the UK, Transport Command aircraft have evacuated wives and children of Government personnel made homeless. Shackletons of three Coastal Command Squadrons, Nos 42, 204 and 210, were engaged in "Sky Help"; and Britannias of 99 and 511 Squadrons and Hastings of 24 (Commonwealth) Sqn, Transport Command.



DHC-4 Caribou for the Ghana Air Force, seen at Downsview, Ont, earlier this year

Beneficent Pioneers

"THE squadron may be small, but it carried out this mammoth task magnificently": these were the words used by a senior Kenya Government official to describe the supply-dropping operation carried out in Kenya by 21 Sqn, to aid Africans marooned by floods in East Africa. "Such flood relief would not have been possible without the Twin Pioneers," said the official in reference to the aircraft which since Operation Tana Flood began in early October flew a total of 257hr on 146 sorties and dropped 254,637lb of food. Another 11,640lb of food was landed. The squadron, which has four Twin Pioneers and a staff of 37, was until recently commanded by Sqn Ldr W. J. Bishop, who formed the squadron at Abingdon (*Flight* August 21, 1959). He has now returned to the UK and handed over command to Sqn Ldr G. M. Scarrott.

Plymouth to Ankara

A CENTO (Central Treaty Organization) post has been announced for AVM L. W. C. Bower, CB, DSO, DFC, at present AOC No 19 Group, Coastal Command. He is to be British representative on the Permanent Military Deputies Group of the organization, with the acting rank of air marshal, and expects to go to Ankara at the end of April. AVM Bower has commanded 19 Group since May 1959. He was previously Deputy Commander-in-Chief, Middle East Air Force.

Thirteenth ROC Headquarters

FIRST Royal Observer Corps underground Group Headquarters to be built in the London and Home Counties area, and the thirteenth to be constructed, was opened on Saturday last by the Mayor of Watford, Councillor J. R. Hicks. Thirty-one of these headquarters and some 1,500 underground monitoring posts are planned.

Foundations of the new building at Watford, the HQ of 5 Group, lie some 20ft below ground. The roof is heavily reinforced with a high degree of protection against fall-out. Facilities provided enable observers to live in it "comfortably and healthily for a considerable time," according to an Air Ministry description. A GPO telephone exchange is connected to 150 lines which can be automatically switched to ROC posts and control centres and to Fighter Command headquarters.

IN BRIEF

Units accidentally omitted from the Battle of Britain memorial window in Westminster Abbey—including Nos 235, 236 and 248 Sqns—are now being incorporated.

A Westland Wasp is to operate in an anti-submarine role from HMS *Ashanti*, first of the new Tribal class of general-purpose frigates, which today (November 23) was being accepted for service with the Royal Navy. This is the first time a helicopter has been carried as an integral part of a ship's armament.

Royal Air Force Britannias and Canberras in part of the main Bristol Aircraft assembly hall at Filton where the Britannias are undergoing major overhauls and the Canberras are being modified

"Flight" photograph

Commercial Aircraft of the World

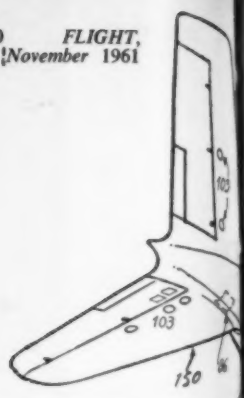
A "FLIGHT" SPECIAL SURVEY, No 6 IN AN ANNUAL SERIES

THIS is our sixth annual survey of the world's commercial aircraft, compiled by the Air Transport Editor and illustrated with drawings by "Flight" technical artists. This year we have decided to omit the engineering cutaway drawings that have been a feature of previous issues. In their place, in the belief that they fulfil a greater need in the airline operating industry, we have included a larger number of the exclusive "Flight" airline operators' reference drawings. Illustrations of this kind appeared in the previous two annual surveys, but were fewer in number and less detailed. A note overleaf explains the purpose and presentation of these drawings.

The survey covers all commercial transport aircraft which are in service, in production, or projected. A line has been drawn, with a few exceptions, above a maximum take-off weight of 10,000lb. A brief history of each type is given, with the salient dates in its development; a list of orders is included for each of the types currently in production; basic, new or typical current resale prices are quoted wherever possible; and powerplant, dimensions, weights, fuel capacity, payload accommodation and performance are presented in standardized form—as supplied, in answer to questionnaires, by the manufacturers. In the few instances where manufacturers have not returned completed questionnaires (the only major example is Convair), figures published in the previous issue, brought up to date with information published since, have been included.

Obviously, perfection in a compilation of this kind, which contains some ten thousand items of information, is difficult to achieve—particularly in respect of the older aircraft now out of production, weights of which have gone up over the years and which have been extensively modified. We therefore welcome comments of the kind received last year from an Argonaut skipper who wanted to know who had heard of an Argonaut cruising at 329 m.p.h.; and from the DC-3 operator who doubted very much whether a DC-3 with maximum fuel could carry a payload of 8,600lb over a stage-length of 2,505 st miles.

EXPLANATORY NOTES: In the data lists "cabin volume" and "maximum usable floor area" are exclusive of the flight deck; "baggage and freight volume" is exclusive of the passenger cabin; and "weight less fuel and payload" is the weight of the aircraft otherwise ready for service. Payload-range performance is quoted on a theoretical no-reserves basis for the purpose of comparison. Range with maximum payload (range A), and ultimate range with maximum fuel (range B) are stated for operations in still-air, ISA conditions at optimum speeds and altitudes. Construction of a payload-range sketch is made possible by inclusion of the payload that can be carried over range B. Cost curves have not been included, because these are valueless unless they are drawn to a very carefully defined set of common assumptions.



Seen here at Vnukovo Airport, Moscow are (left to right) Antonov An-10A, An-14 Pchelka ("Bee") and An-24

THE operators' reference drawing opposite is one of 22 "Flight" copyright drawings distributed through this special feature. The intention is to show the tasks for which the more important commercial aircraft are suited, and some of the features that are in constant use when the aircraft is in service. Approximately to scale, the drawings provide a quick reference to cabin dimensions, doors, access hatches, refuelling points, and other details. The standard key below applies to all 22 drawings, though not every item is applicable to every drawing. Inevitably, and particularly in the case of the drawings of Soviet aircraft, the annotations are incomplete, because manufacturers' full information has not been forthcoming in every case. Incomplete annotation on the drawings of some of the newer aircraft is likewise inevitable, because detail design may not yet have been finalized. Absence of any particular key number from a drawing does not necessarily imply that the particular item concerned is not to be found in the aircraft. In general, the outline of the cabin volume is lightly shaded, while line-tone shading is used to denote freight and baggage space. Volumes and linear dimensions are indicated. Seating illustrated in the cross-sections is a typical layout shown by the manufacturer—i.e., four-, five, or six-abreast (the sketches do not represent any particular make of chair). Fuselage doors are indicated on each section, and heavy black lines show if they are of the inward- or outward-opening variety.

1 Pressure bulkheads
2 Passenger door
3 Crew door
4 Service door
5 Emergency door
6 Emergency window or hatch
7 Cargo doors
8 Fixed toilets
9 Radio racks
10 Galley, pantry or buffet
11 Main-undercarriage well
12 Nosewheel well
13 Reverse-pitch propellers
14 Glass-fibre fuel tank
15 Integral fuel tanks
16 Bag tanks
17 Thrust reversers
18 Noise suppressors
19 Escape chutes
20 Escape ropes
21 Folding entry stairs (optional)
22 Jacking points
23 Towing points
24 Water-methanol tank
25 Water tanks
26 Dinghy stowage
27 De-icing air in/out
28 Intake to air conditioning
29 Electrical de-icing
30 Seat rails
31 De-icing system access
32 Hydraulic tank
33 Fuel jettison
34 Batteries
35 Anti-skid device
36 Air brakes
37 Captain
38 First Officer
39 First Officer/Navigator
40 Navigator
41 Engineer
42 Radio operator
43 Braking parachute
44 Gravity fuel fillers
45 Pressure refuelling/defuelling
46 Oil fillers
47 Water fillers
48 Water-methanol fillers
49 Oxygen containers
50 Oxygen filler
51 Windscreen de-icing filler
52 Hydraulic fluid filler
53 Pressure-accumulator filler/inflator
54 HF
55 VHF
56 VOR
57 DME
58 ADF
59 Radio altimeter
60 General access panel
61 ILS
62 Loran
63 Electrical service bay
64 Hydraulic service bay
65 Air conditioning equipment
66 Fire suppression bottles
67 Dripsticks
68 Fuel tank access
69 Booster pump access
70 Gauge unit access
71 Feed tank/pump sump
72 Landing lamp
73 Taxi lamp
74 Landing/taxi lamp
75 Anti-collision beacon
76 Icing inspection lamps
77 Flap gear access
78 Control lock jack access
79 Other aerials
80 Generator
81 Bleed door
82 Thermocouples
83 Engine hoist
84 Low pressure fuel cock
85 Weather radar
86 Flying control access
87 Flying control power unit access
88 Auxiliary gearbox
89 Ground intercom. socket
90 External electrical supply
91 Ground air conditioning connection
92 Fire access
93 Access to structural joint
94 Access to gyro compass unit
95 Compass detector unit
96 Picketing points
97 Toilet servicing points
98 Fuel pipe access
99 Engine access
100 Jetpipe access
101 Ground de-icing connection
102 Hinged/removable leading edge
103 Trim gear access
104 Windscreen-wiper pumps filler
105 Spares stowage area
106 Periscopic sextant
107 Pneumatic reservoir
108 De-icing fluid tank
109 Liquid de-icing
110 Spoilers
111 Freight-lashing points/rails
112 Freight-lashing access panel
113 Steering angle
114 Freight winch
115 Retractable supports
116 Teletype loop
117 Doppler
118 Decca
119 UHF
120 TACAN
121 Automatic-landing aerial
122 Air to APU
123 APU access
124 Combustion heater access
125 Supercharger access
126 Safety-line fittings
127 Window size (inches)
128 Freight-door operating handle
129 Actuator (loading facilities)
130 Electric windscreen wipers
131 Fuel-tank vent
132 Alternator
133 ATC aerial
134 Floor loading (lb/sq ft minimum)
135 Signal-cartridge dischargers
136 Diplomatic-mail locker
137 Lift dumper (to destroy lift after touch-down)
138 Drop-out ram-air turbine
139 Drooping leading edge
140 Hot air de-icing
141 Pallet tracks and rails
142 Leading-edge slats
143 Supernumerary crew
144 Flight-recorder
145 Pneumatic starter ground-supply
146 Leading-edge flap
147 Flares
148 Crew-rest area
149 End-loading entry dimensions
150 Pneumatic de-icing
151 Cabin-air compressor

ANTONOV One of the USSR State Aircraft industry's chief designers, Oleg Konstantinovich Antonov, has given his name to four transport aircraft designs for service with Aeroflot, as follows:—

An-2 The prototype of this ubiquitous single-engined biplane transport flew in 1947, and it is said that more than 2,000 have been built for military and civil use. The standard 8-12 seater is an An-2P, powered by one ASh-62IR radial engine of 1,000 h.p. Variants are the An-2S (agricultural), An-2V (floatplane, Antonov design number An-6), and An-2ZA (high-altitude met, design number An-4). Brief data on the standard An-2P are as follows:—

Powerplant: One ASh-62IR piston engine of 1,000 h.p., driving a four-blade constant-speed propeller.

Dimensions: Span, 59ft 7in; length, 42ft.

Weights: Max take-off 11,600lb.

Payload accommodation: Seats for 8-12 passengers.

Performance: Cruising speed, 107kt (124 m.p.h.); minimum speed, 35kt (40 m.p.h.); landing run, 500ft approx.

An-10A A standard Aeroflot transport, the An-10A is the production version of the An-10, which first flew early in 1957. The An-10A has soft tyres and a four-wheel bogie undercarriage to permit it to operate from grass strips. There is a military aft-loading version.

Powerplant: Four Ivchenko AI-20 turboprops of 4,000 e.s.h.p. each, driving four-blade propellers of about 14ft 9in diameter.

Dimensions: Span, 124ft 8in; length, 121ft 4in; height, 32ft 1in; wing area, 1,293 sq ft.

Weights: Max take-off, 121,500lb; capacity payload, 32,000lb; fuel weight, 22,600lb.

Payload accommodation: Cabin, 7,840 cu ft; cabin max height, 108in; cabin width, 13ft 6in; baggage and freight, 1,483 cu ft; max seats, 126.

Fuel capacity: 2,800 Imp gal approx.

Performance: Cont cruising speed, 345kt (395 m.p.h.) at 26,000ft; take-off run, 2,130ft to 2,300ft; landing run, 1,640ft; range (take-off to landing) with 32,000lb payload, 1hr fuel reserves, 1,080 n.m. (1,240 st.m.); range with 23,000lb payload, 1hr fuel reserves, 1,670 n.m. (1,925 st.m.); range with 18,600lb payload, 1hr fuel reserves, 1,850 n.m. (2,130 st.m.).

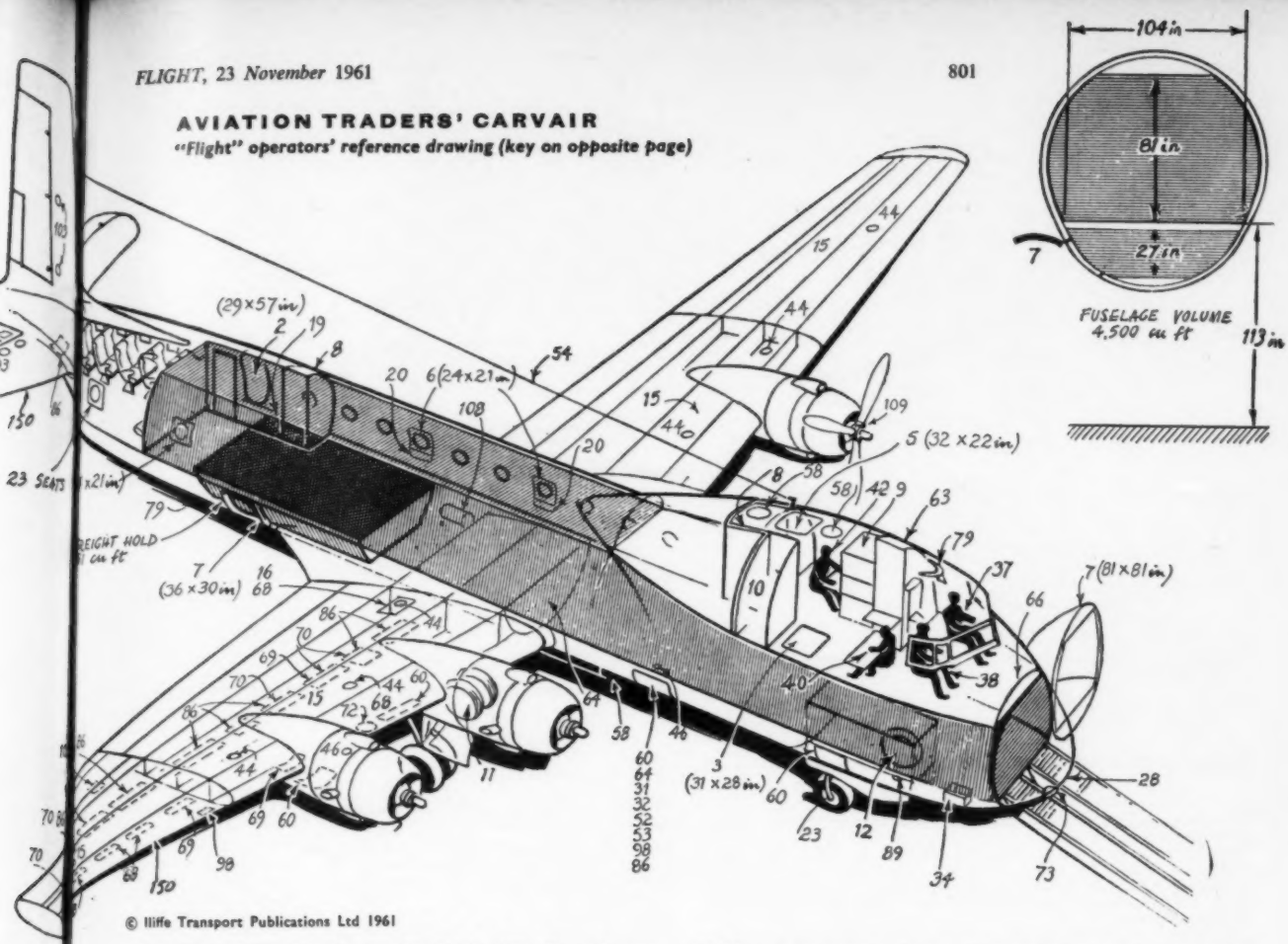
An-12 This is a military transport version of the An-10 having, apparently as standard, a rear gun turret. A number have been delivered to the Indian Air Force and one to Ghana Airways.

An-14 Pchelka ("Bee") This light utility transport, powered by two 260 h.p. piston engines, is comparable with the Short Skyvan, though it is smaller. It is in Aeroflot service. It first flew on March 15, 1958. The field performance claimed for the An-14 puts it in the STOL class, and it has a minimum speed claimed to be no more than 27kt (31 m.p.h.). It appears to have seating accommodation for six people, including one pilot. Large rear-loading doors are fitted.

Powerplant: Two Ivchenko AI-14R piston engines of 260 b.h.p., driving two-bladed 9ft 4in propellers.

AVIATION TRADERS' CARVAIR

"Flight" operators' reference drawing (key on opposite page)



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Dimensions: Span, 65ft; length, 36ft; height, 13ft 10in; wing area, 474 sq ft; aspect ratio, 9.

Weights: Take-off, 6,615 lb; max permitted take-off, 7,055lb; payload, 1,320lb.

Payload accommodation: Typically six seats.

Performance: Max speed, 124kt (143 m.p.h.); cruising speed, 113kt (130 m.p.h.); take-off run, 130ft; landing run, 195ft; landing speed, 36kt (41 m.p.h.); min speed, 27kt (31 m.p.h.); rate of climb, 835ft/min, or 235ft/min on one engine; max range, 540 n.m. (620 st.m.).

An-24 First reference to this feeder liner, in the same class as the Friendship, Dart Herald and Avro 748, appeared in June 1960. The chief of Aeroflot was reported as having said that it would carry 32 passengers in the standard version and 40 in a high-density configuration at a cruising speed of up to 326 m.p.h. Range is said to be of the order of 900-1,240 miles and take-off distance about 1,600ft. Another report states that take-off run does not exceed 1,000ft. According to Mr Antonov, speaking in England last September, the type had not then entered service.

Powerplant: Two Ivchenko turboprops of 2,000 s.h.p.

ARMSTRONG WHITWORTH See Whitworth Gloster for AW.650 Argosy family.

AVIA *Ceskoslovenské Závody Automobilové A Letecké, Palackého Nam 4, Prague 2.*

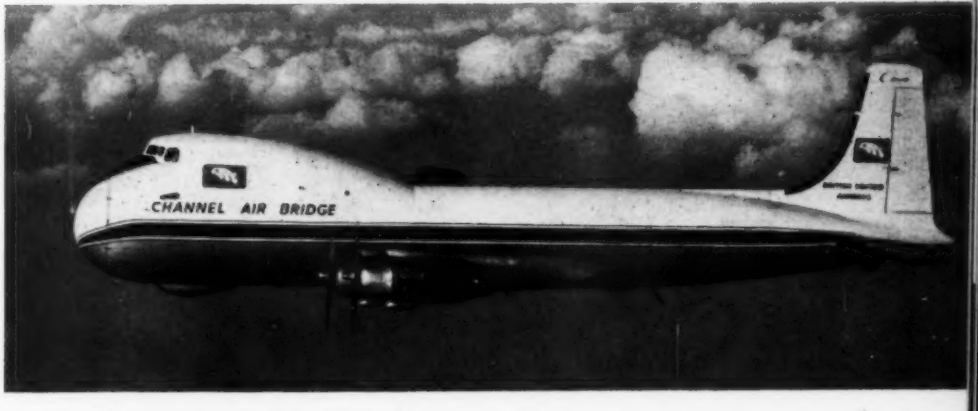
Manufacturers of the Avia 14 (Il-14M): see Ilyushin.

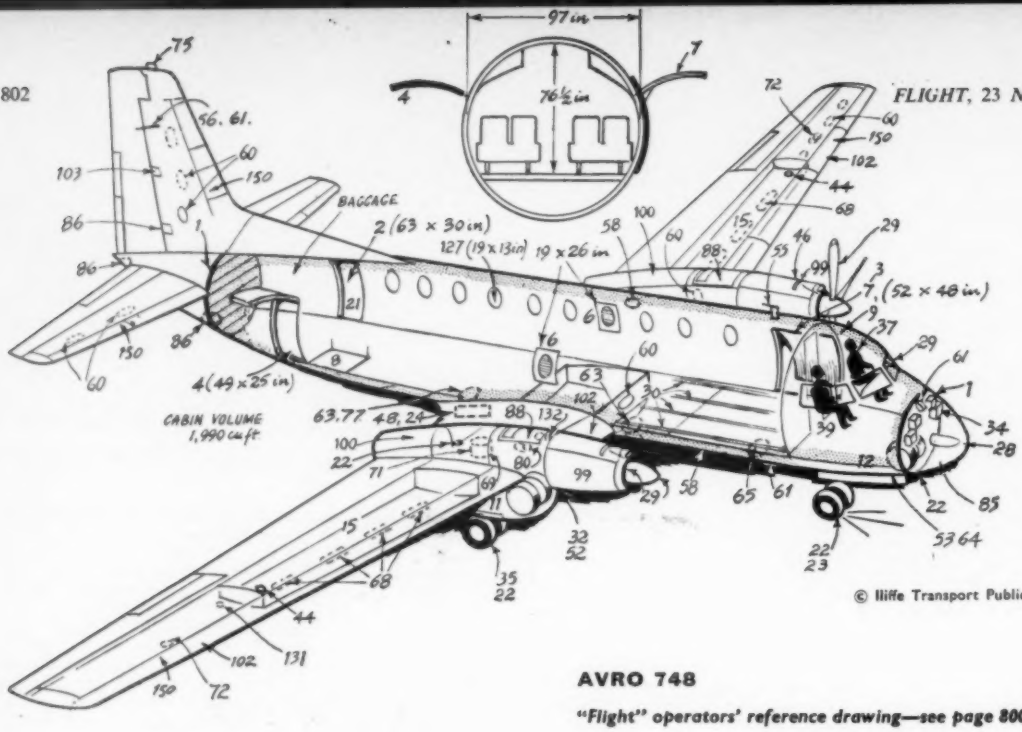
AVIATION TRADERS *Aviation Traders (Engineering) Ltd, 21 Wigmore Street, London, W.1.*

ATL-98 Carvair This is a modification of the DC-4, ten of which are to be produced for Channel Air Bridge, a British United Airways company. The sale of Carvairs to a number of other airlines is also under negotiation. Modification involves a completely new forward body, in which the cockpit has been raised to provide nose-loading through a single door, and an extended fin and rudder. These changes make available at low cost a four-engined nose-loading freighter of substantial capacity and long range, or a car-ferry aircraft capable of accommodating five medium-sized or six small cars, at operating costs comparable with those of the Bristol Freighter. The first flight of the Carvair was on June 21, 1961, and the aircraft will be ready for service in December. It will be used by Channel Air Bridge on vehicle-ferry services to destinations on the Continent.

Flight references: June 19, 1959, June 24, 1960 and November 18,

The first of ten ATL-98 Carvairs for Channel Air Bridge





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AVRO 748

"Flight" operators' reference drawing—see page 800 for key

Commercial Aircraft of the World . . .

1960. Dimensions are as given in *Flight* for November 18, 1961, except for height empty, 29ft 10in.

Weights: Max take-off, 73,800lb; landing, 64,170lb; zero fuel, 59,000lb or 60,700lb; capacity payload, car ferry, 16,800lb (ZFW 59,000lb) or 18,500lb (ZFW 60,700lb); unfurnished freighter, 18,542lb (ZFW 59,000lb) or 20,242lb (ZFW 60,700lb); weight less fuel, crew and payload, 40,008lb.

Payload accommodation: Cabin volume, 4,500 cu ft; baggage volume, 151 cu ft; cabin length, 80ft 2in; max width 9ft 3in; max height, 6ft 9in; max usable floor area, 665 sq ft; dimensions of largest door 80in × 81in; max seats (subject to ARB requirements), 84; cars 4-6, plus rear seats for 23.

Fuel capacity: 6-tank version, 2,396 Imp gal (2,876 US gal); 8-tank version, 2,998 Imp gal (3,600 US gal).

Performance: Opt-cost (i.e., typical) cruising speed at 5,000-10,000ft and 65,000lb, 178kt (205 m.p.h.); corres s.f.c., 0.446lb/b.h.p./hr; take-off field length to 50ft, ISA, SL, max weight, 4,200ft; landing field length from 50ft, ISA, SL, unfactored max landing weight, 2,790ft; range A (max payload) 2,160 st.m. (versions with 6 or 8 tanks and ZFW of 59,000lb) or 1,895 st.m. (versions with 6 or 8 tanks and ZFW of 60,700lb); range B (max fuel), 2,630 st.m. (6-tank version with ZFW of 59,000lb or 60,700lb) or 3,325 st.m. (8-tank version with ZFW of 59,000lb or 60,700lb); VNE, 217kt IAS; VNO, 195kt IAS; VSO, 73kt IAS.

G-ARAY is the second prototype Avro 748 Series 1

AVRO *A. V. Roe & Co Ltd, Greengate, Middleton, Manchester.* (*Member of the Hawker Siddeley Group*)

Avro 748 Announced on January 9, 1959, the 748 is a contender for the so-called DC-3 replacement market. Like its main competitors, the Handley Page Herald and the Fokker Friendship, it is powered by two Rolls-Royce Dart turboprops. The Series 1 has RDa.6 Darts and the Series 2 has RDa.7s which makes it suitable particularly for operation in "hot and high" conditions. The prototype 748 first flew on January 24, 1960. The Avro **748E** is a Series 2 with a 6ft extension in the fuselage, 3ft on each side of the wing. Also projected is a development of the E, the **Super E**, powered by Dart RDa.10s and with a maximum weight increased to 43,000lb. The order book is as follows: Skyways, three Series 1 (March to May, 1962); BKS, five Series 1 (1962); Aerolineas Argentinas, nine Series 1 (1961-62); Aden Airways, three Series 2 (June 1962). The first three 748s have now flown a total of some 1,200hr, and the final stage of the certification programme began on November 6 when Skyways began a 160hr programme of route tests, due to end as this issue appears. Certification should be achieved during the course of next month. The first Indian-assembled aircraft made its maiden flight at Kanpur on November 1. The Indians will build a large number of 748s for the Indian Air Force, following assembly of a number of Avro-manufactured aircraft, including three Series 2s. No details are available of 748 development projects, including the **758**, a military version with rear loading, and the **778**, a version with two aft-mounted jets in place of the wing-mounted turboprops. Production of sixty 748s of all versions is envisaged at the present time. Basic price of the Series 1 is £200,000, of the Series 2 £231,000, and the Series E £260,000.

Avro 748 Series 1

Powerplant: Two Rolls-Royce Dart RDa.6 Mk 514 turboprops of 1,740 e.h.p. each driving Rotol 12ft four-blade propellers.

Dimensions: Span, 95ft; length, 67ft; height empty, 24ft 10½in; wing area, 795 sq ft.

Weights: Max take-off, 36,800lb; landing, 36,300lb; zero fuel, 33,200lb; capacity payload, 10,586lb; weight less fuel and payload, 22,614lb.

Payload accommodation: Cabin volume, 1,990 cu ft; baggage and freight volume, variable; cabin length, 46ft 6in; max internal width, 8ft ½in; max height, 6ft 4in; max usable floor area, 296 sq ft; dimensions of largest door, 52in × 48in; max seats, 48 at 30in pitch.

Fuel capacity: 1,140 Imp gal.

Water-methanol capacity: 60 Imp gal.

Performance: Typical cruising speed, 220kt at 20,000ft and 34,000lb; corres fuel consumption, 0.172 n.m./lb; balanced field length, max take-off weight, SL, ISA, 3,300ft; landing field length, SL, 3,600ft; range A (max payload), 550 n.m.; range B (max fuel), 1,520 n.m.; corres payload, 5,070lb; VNE, 270kt IAS; VNO, 205kt IAS; VSO, 68kt IAS.

Avro 748 Series 2

Powerplant: Two Rolls-Royce Dart RDa.7 Mk 531 turboprops of 2,105 e.h.p. each driving Rotol 12ft four-blade propellers.

Dimensions: As Avro 748 Series 1.

Weights: Max take-off, 38,800lb; max landing, 38,000lb; zero fuel, 34,050lb; capacity payload, 10,986lb; weight less fuel and payload, 23,064lb.

Payload accommodation: As Avro 748, Series 1.

Fuel capacity: As Avro 748, Series 1.

Water-methanol capacity: As Avro 748, Series 1.

Performance: Typical cruising speed, 245kt at 20,000ft and 38,000lb;

Northwest Orient is one of the latest operators of the turbofan Boeing 720B

corres fuel consumption, 0.164 n.m./lb; take-off field length, SL, ISA, 3,640ft; landing field length, SL, 3,790ft; range A (max payload), 800 n.m.; range B (max fuel), 1,670 n.m.; corres payload, 6,620lb; VNE, 270kt IAS; VNO, 225kt IAS; VSO, 71kt IAS.

Avro 748E

Powerplant: As Series 2.

Dimensions: As Series 1 and 2 except length, 73ft.

Weights: Max take-off, 40,100lb; landing, 39,600lb; zero fuel, 37,000lb; capacity payload, 13,000lb; weight less fuel and payload, 24,000lb.

Payload accommodation: Cabin volume, 2,250 cu ft; baggage and freight volume, variable; cabin length, 52ft 6in; max internal width, 8ft $\frac{1}{2}$in; max height, 6ft 4in; max usable floor area, 335 sq ft; dimensions of largest door, 52in × 48in; max seats, 60 at 29in pitch.

Fuel capacity: As Series 1 and 2.

Water-methanol capacity: As Series 1 and 2.

Performance: Typical cruising speed, 245kt at 20,000ft and 38,000lb; corres fuel consumption, 0.164 n.m./lb; take-off field length, SL, ISA, 3,900ft; landing field length, SL, 3,900ft; range A (max payload), 500 n.m.; range B (max fuel), 1,610 n.m.; corres payload, 7,000lb; VNE, 270kt IAS; VNO, 225kt IAS; VSO, 71kt IAS.

BAADE **BB-152** This East German jet airliner, details of which appeared in *Flight* for November 18, 1960, page 821, is reported to have been abandoned following contraction and reorganization of the national aircraft industry.

BOEING *The Boeing Company, Transport Division, Renton, Washington, USA.*

Boeing 307 Stratoliner First flown on December 31, 1938, the Stratoliner was a civil development of the B-17 bomber. Of the same generation as the DC-4, and a direct competitor, it went into service with Pan American and TWA in the early months of 1940. It was an airliner in advance of its time, being the first pressurized airliner to go into service, and although only ten were built, eight remain in service to this day: Cohata (1), Airnautic (1), Aigle Azur (5) and Air Vietnam (1).

Powerplant: Four Wright R-1820-G102As of 1,100 b.h.p. each; max weight, 42,000lb; span, 107ft 3in; wing area, 1,486 sq ft; cruising speed, 174kt (200 m.p.h.); typical number of seats, 33.

Flight reference: May 23, 1958, pages 712-714.

Boeing 377 Stratocruiser The Stratocruiser was developed from the YC-97, a transport derivative of the B-29 bomber. The first YC-97 flew in November 1944. The Stratocruiser was ordered by Pan American, Northwest, United, American, BOAC and SAS (whose order was subsequently transferred to BOAC). The aircraft entered service in 1949, and its renowned comfort maintained its position in the front rank until as recently as 1958, when it was still in service with both Pan American and BOAC on the North Atlantic run. Altogether a total of 56 were built. No reliable evidence of any in service is available.

A total of 888 C-97 transports and KC-97 tankers were built for the US Air Force.

Powerplant: Four Pratt & Whitney Wasp Major R-4360-B6 of 3,500 b.h.p. each driving 16$\frac{1}{2}$ft Hamilton Standard propellers.

Data appeared in *Flight* for November 20, 1959, page 582.

Boeing 707/720 The 707/720 family of Boeing jet airliners, which were developed as a private venture out of the company's unique jet bomber (B-47, B-52) experience, comprises six types of transport, listed below.

The prototype 707, the 367-80, which first flew in July 1954, led to a big USAF order for KC-135 jet tankers. More than 400 of these have been delivered against an order for a total of 426, contributing significantly to the commercial production programme. In addition, 30 C-135A freighters (Stratolifer) are being delivered.

The first 707 order came on October 13, 1955, from Pan American; the first 707-120 flew on December 20, 1957; and deliveries (to PanAm) began in September 1958 ahead of schedule. The 707 was introduced into regular service across the North Atlantic (by PanAm) on October 26, 1958. To date about 240 707s and 720s have been delivered to 23 operators (plus the USAF) and the order book stands at 324 for 27 operators:

707-120 American, 26 (modified to 120B standard); Continental, 5; Cubana, 2 (leased by Boeing to Western Air Lines); PanAm, 6; Qantas, 7 (shorter 220-size body and modified to 120B standard); TWA, 15; USAF Military Air Transport Service, 3 (VC-137A).

707-120B American, 1; Qantas, 4; TWA, 20.

707-220 Braniff, 5.

707-320 Air France, 20; PanAm, 26 (one leased to PIA); Sabena, 7; SAA, 3; TWA, 12.

707-320B PanAm, 5; TWA, 6; Air France, 4.

707-420 Air-India, 6; BOAC, 15; El Al, 3; Lufthansa, 5; Varig, 2; Cunard Eagle, 2.

720 Aerlinte (Irish), 3; American, 10 (modified to 720B standard); Braniff, 4; Eastern, 15; United, 29; Pacific Northern, 2; FAA, 1.

720B American, 15; Avianca, 2; Ethiopian, 2; Lufthansa, 8; Western, 4; El Al, 2; Continental, 4; Northwest, 9; Pakistan, 3.

707-120 This is the JT3 domestic model. Basic price: about £1.68m.

Powerplant: Four Pratt & Whitney JT3C-6 turbojets of 11,200lb dry thrust each, or 13,500lb with water injection.

Dimensions: Span, 130ft 10in; length, 144ft 6in; height empty, 42ft; wing area, 2,433 sq ft; sweep at quarter chord, 35°; aspect ratio, 7.07.

Weights: Max take-off, 247,000lb; landing, 175,000lb; zero fuel, 165,000lb; capacity payload, 43,000lb; weight less fuel and payload, 122,000lb.

Payload accommodation: Cabin volume, 7,653 cu ft; baggage and freight, 1,680 cu ft; cabin length, 104ft 10in; max width, 12ft 4in; max height, 14ft 2$\frac{1}{2}$in; max usable floor area, 1,092 sq ft; dimensions of largest door, 34in × 72in; max seats, 179.

Fuel capacity: Basic, 11,223 Imp gal (13,478 US gal).

Water capacity: 591 Imp gal (710 US gal).

Performance: Cont cruising speed, 495kt (570 m.p.h.) at 28,000ft and 180,000lb; balanced field length at max take-off weight, SL, ISA, 10,200ft; landing distance from 50ft at max landing weight, 6,000ft; range A (max payload), ISA (SR427 reserves), 2,720 n.m. (3,130 st.m.); range B (max fuel) (SR427 reserves), 3,750 n.m. (4,310 st.m.); corres payload, 20,500lb.

707-120B The 707-120B is distinguished by turbofan engines and the wing modifications applied to the 720, namely, three sections of leading-edge flap and a false leading edge between inner pod and fuselage. Changes are also made to the main gear and cabin-air turbo-compressors. The result will be improved field performance, increased economy, and an increase in high-speed cruise of 18kt. These changes can be incorporated retrospectively.

Powerplant: Four Pratt & Whitney JT3D-1 turbofans of 17,000lb dry thrust at sea level, ISA + 31°F.

Dimensions: As 707-120.

Weights: Max take-off, 258,000lb; max landing, 185,000lb; zero fuel, 170,000lb; capacity payload, 47,734lb; weight less fuel and payload, 122,266lb.

Payload accommodation: As 707-120.

Fuel capacity: 14,400 Imp gal (17,258 US gal) plus 358 Imp gal (430 US gal) water.

Performance: Optimum-cost cruise, 484kt (557 m.p.h.) at 35,000ft and 200,000lb; corres consumption, 11,300lb/hr; balanced field length, max weight, ISA, 8,700ft; max landing weight, 6,200ft; range A (max payload), 3,725 n.m. (4,289 st.m.); range B (max fuel), 5,392 n.m. (6,209 st.m.); corres payload, 18,830lb; corres speed, 461kt (530 m.p.h.) at 37,500ft.

707-220 This is a shorter-body domestic version, powered by JT4s, ordered by one customer, Braniff. This operator wanted a higher reserve of power to meet the high-altitude, high-temperature conditions experienced on its Latin American routes.

Powerplant: Four Pratt & Whitney JT4A-3 turbojets of 15,800lb dry thrust each (no water injection).

Dimensions: As for the -120, except for length, 134ft 6in.

Weights: As for the -120, except for capacity payload, 34,000lb.

Payload accommodation: Approximately as for the -120.

Fuel capacity: As for the -120, but without water.

Performance: Cont cruise speed, approx as for -320; balanced field length, max take-off weight, SL, ISA, 6,900ft; landing distance from 50ft at max landing weight, 6,000ft; range A (max payload), 2,980 n.m. (3,430st.m.); range B (max fuel) (SR427 reserve), 3,875 n.m.

707-320 Known as the Intercontinental, the -320 is the long-range model.

Powerplant: Four Pratt & Whitney JT4A-11 of 17,500lb thrust each (no water injection).

Dimensions: Span, 142ft 5in; length, 152ft 11in; height empty, 42ft 5$\frac{1}{2}$in; wing area, 2,892 sq ft; sweep at 0.25 chord, 35°.

Weights: Max take-off, 311,000lb; landing, 207,000lb; zero fuel, 190,000lb; capacity payload, 56,594lb; weight less fuel, crew and payload, 133,406lb.

Payload accommodation: Cabin volume, 8,150 cu ft; baggage and freight volume, 1,785 cu ft; cabin length, 111ft 6in; max width, 12ft 4in;

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max height, 14ft 2½in; max usable floor area, 1,164 sq ft; dimensions of largest door, 34in × 72in; max seats, 189.

Fuel capacity: 19,831 Imp gal (23,815 US gal).

Performance: Cont cruising speed, 472kt (544 m.p.h.) at 35,000ft and 240,000lb; corres consumption, 13,900lb/hr; balanced field length (max weight, SL, ISA), 10,300ft; max landing weight, 7,300ft; range A (max payload), 4,042 n.m. (4,654 st.m.); range B (max fuel), 5,932 n.m. (6,831 st.m.); corres payload, 19,440lb.

707-320B This is the Intercontinental fitted with turbofan engines and increased payload-range performance.

Powerplant: Four Pratt & Whitney JT3D-3 (wet) turbofans of 18,000lb thrust each.

Dimensions: As -320, except span, 145ft 9in.

Weights: Max take-off, 312,000lb; max landing, 207,000lb; zero fuel, 190,000lb; capacity payload, 53,666lb; weight less fuel and payload, 136,334lb.

Payload accommodation: As -320.

Fuel capacity: As -320.

Water capacity: 416 Imp gal (500 US gal).

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 240,000ft, 472kt (M = 0.82); corres s.f.c., 0.9; take-off field length, SL, ISA, 312,000lb, 9,770ft; landing field length, SL, 207,000lb, 6,420ft; range A (max payload), 4,980 n.m.; range B (max fuel), 7,010 n.m. with 18,600lb payload; cruise M.82, VNE, 383kt IAS; VNO, 340kt IAS at SL to 383kt IAS at 25,200ft; VSO 98.4kt IAS at 207,000lb; MNO and MNE = 0.90.

707-420 This is the Rolls-Royce Conway-powered version, also known as the Intercontinental, as ordered by BOAC, Air India, Lufthansa and Varig.

Powerplant: Four Rolls-Royce Conway 508 (RCo.12) of 18,000lb thrust each (no water injection).

Dimensions: Span, 142ft 5in; length, 152ft 11in; height empty, 42ft 5½in; wing area, 2,892 sq ft.

Weights: Max take-off, 311,000lb; landing, 207,000lb; zero fuel, 190,000lb; capacity payload, 59,124lb; weight less fuel and payload, 130,876lb.

Payload accommodation: Cabin volume, 8,150 cu ft; baggage and freight volume, 1,773 cu ft; cabin length, 111ft 6in; max width, 12ft 4in; max height, 14ft 2½in; max usable floor area, 1,164 sq ft; dimensions of largest door, 34in × 72in; max seats, 189.

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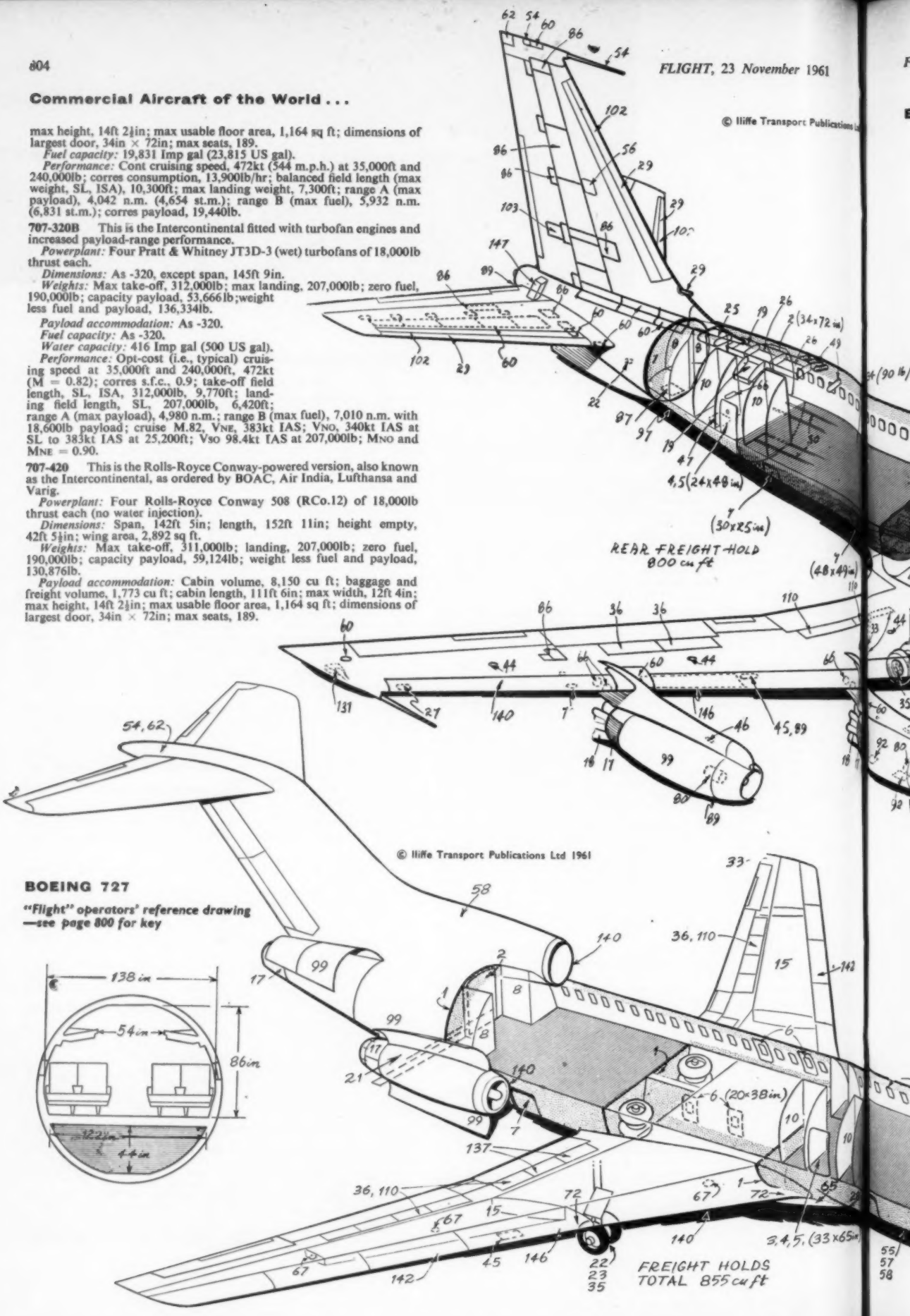

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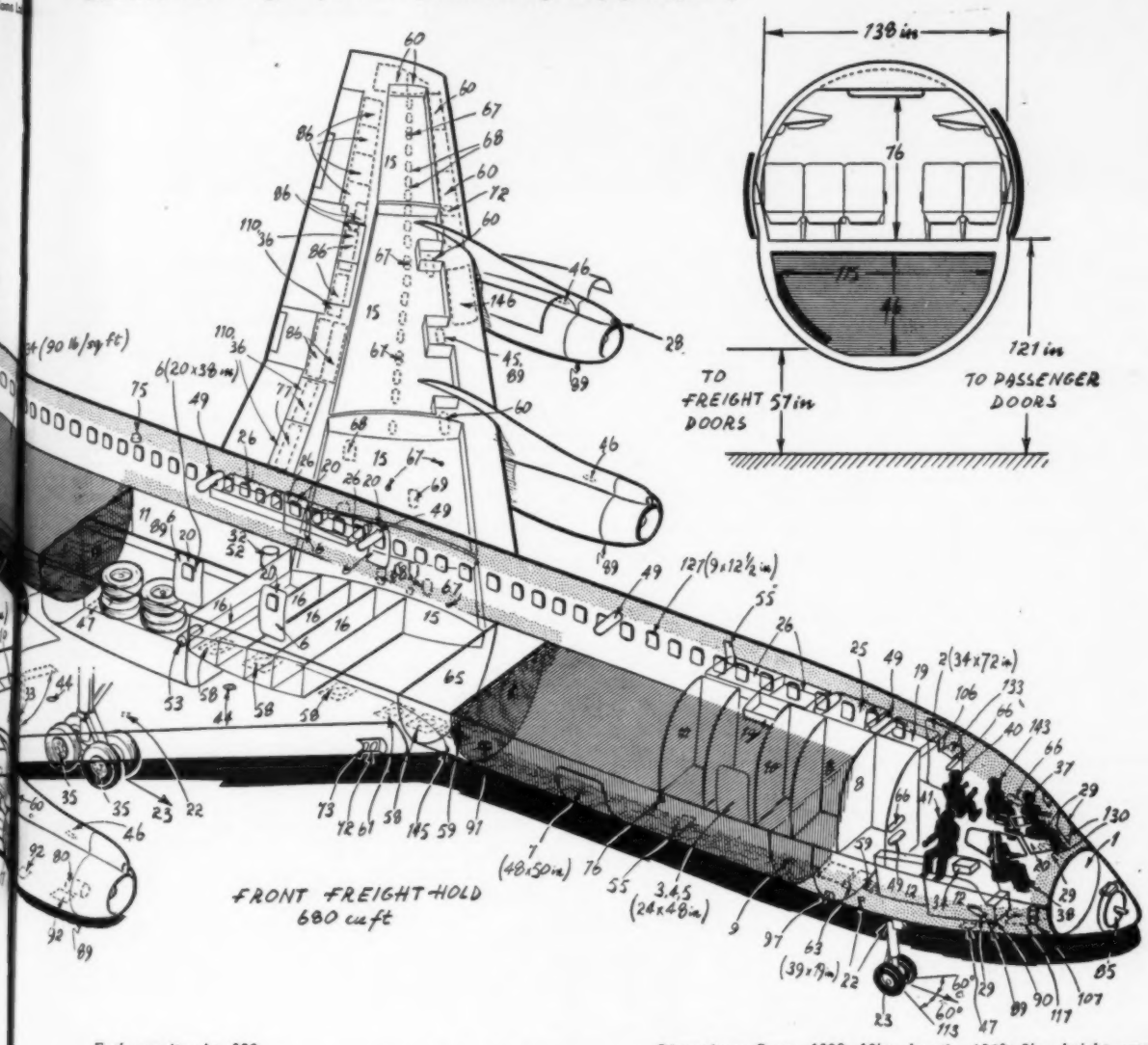
BOEING 727

"Flight" operators' reference drawing
—see page 800 for key

BOEING 707 ***"Flight" operators' reference drawing—see page 800 for key***

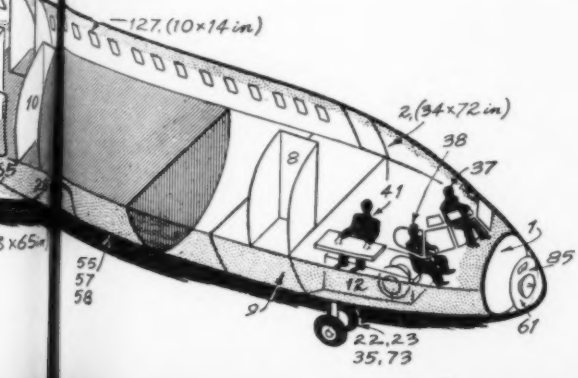


Fuel capacity: As -320.

Performance: Cont cruise speed, 472kt (544 m.p.h.) at 35,000ft and 240,000lb; corres consumption, 13,500lb/hr; balanced field length, max weight, SL, ISA, 10,700ft; max landing weight, 7,300ft; range A (max payload), 4,339 n.m. (4,997 st.m.); range B (max fuel), 6,199 n.m. (7,139 st.m.); corres payload, 21,800lb.

720 Higher-speed addition to the family, the 720 has the leading edge "glove" which extends the wing chord between fuselage and inner pod to increase Mach number from 0.88 to 0.90. In addition, "lift-booster" leading-edge flaps, three per side, improve landing and take-off characteristics.

Powerplant: Four Pratt & Whitney JT3C-7 turbojets of 12,000lb dry thrust each (no water injection).



Dimensions: Span, 130ft 10in; length, 136ft 2in; height empty, 41ft 6½in; wing area, 2,433 sq ft.

Weights: Max take-off, 202,000lb; landing, 175,000lb; zero fuel, 139,000lb; capacity payload, 33,353lb; weight less fuel and payload, 105,000lb.

Payload accommodation: Cabin volume, 7,618 cu ft; baggage and freight volume, 1,390 cu ft; cabin length, 94ft; max width, 12ft 4in; max height, 14ft 2½in; max usable floor, 1,003 sq ft; max seats, 149.

Fuel capacity: 9,855 Imp gal (11,835 US gal).

Performance: Cont cruising speed, 484kt (557 m.p.h.) at 35,000ft and 160,000lb; corres consumption, 11,200lb/hr; balanced field length, max weight, SL, ISA, 6,700ft; max landing weight, 6,240ft; range A (max payload), 2,610 n.m. (3,006 st.m.); range B (max fuel), 3,600 n.m. (4,145 st.m.); corres payload, 19,300lb.

720B The improved airframe and aerodynamic features of the 720 are in this aircraft allied with the substantial performance advantages of the Pratt & Whitney JT3D-1 turbofan, rated at 17,000lb thrust (no water injection). Dimensions are the same as those of the 720, but additional wing bays are occupied by fuel. Deliveries start next year.

Weights: Max take-off, 233,000lb; landing, 175,000lb; zero-fuel, 149,000lb; capacity payload, 37,200lb; less fuel and payload, 112,000lb.

Fuel capacity: 12,400 Imp gal (14,830 US gal).

Performance: Cont cruising speed, 484kt (557 m.p.h.) at 35,000ft at 180,000lb; corres consumption, 10,600lb/hr; balanced field length, max weight, SL, ISA, 6,880ft; max landing weight, 6,240ft; range A (max payload), no reserves, 3,885 n.m. (4,474 st.m.); range B (max fuel) no reserve, 5,040 n.m. (5,802 st.m.); corres payload, 19,300lb.

727 First announced in September 1960, the 727 is the three-engined member of the Boeing jet family designed for short-to-medium stage lengths. On December 5, 1960, Boeing announced the signing of con-

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The Breguet 942 may eventually be operated on French domestic routes by Air Inter. The military Br941 is shown

tracts with Eastern Air Lines and United Air Lines for 40 aircraft each. On May 16, 1961, American Airlines signed a letter of intent to purchase 25 727s for delivery in 1964 and this led to a firm contract being signed on August 10. Earlier, in March 1961, the first export breakthrough came with an order for 12 from Lufthansa. The first production jig was loaded in October 1961, and, according to a Boeing schedule published last January, the first aircraft will be rolled out in August 1962 and will fly in November 1962. Deliveries to Eastern and United are due to start towards the end of 1963. General configuration of the aircraft is similar to that of the de Havilland Trident, although the 727 is a rather larger aircraft. Fuselage cross section corresponds with that of the other Boeing jet airliners although the accommodational length is less. Particular emphasis has been placed on field performance, which is well below 6,000ft in standard conditions. Flaps are triple slotted and the leading-edge flaps are of the Krueger type.

Powerplant: Three Pratt & Whitney JT8D-1 turbofans of 14,000lb thrust each.

Dimensions: Span, 108ft 7in; length, 135ft 5in; height, 34ft; wing area, 1,650 sq ft; sweepback at quarter chord, 32°.

Weights: Max take-off, 142,000lb; max landing, 131,000lb; zero fuel, 109,000lb; capacity payload, 24,000lb; weight less fuel and payload, 81,500lb.

Payload accommodation: Freight hold volume, 850 cu ft; cabin length, 72ft 8in; max width, 139in; cabin height, 90.9in; door sizes, as 707 except for ventral door.

Performance: Opt-cost, i.e., typical cruising speed, 515kt at 25,000ft at 120,000lb; take-off field length, ISA, SL, 5,250ft; ISA, 5,000ft elevation, 7,600ft; landing field length required, 4,980ft, SL, ISA; range A (max payload), 3,000 n.m.

737 This is a twin-jet short-haul airliner project. No official details have been published.

BREGUET *Société Anonyme des Ateliers d'Aviation Louis Breguet, 24 Rue Georges Bizet, Paris 16e, France.*

Breguet 763 Deux Ponts The Breguet 763 stems from the earlier Type 761, the design of which was started in 1944 and which flew for the first time on February 15, 1949. The Deux Ponts fuselage is the same as that of the 761 but the span is increased and the wings reinforced; twelve 763s were ordered by Air France in 1951 (it is operated by the French airline under the name Provence) and the prototype flew for the first time on July 20, 1951. The Service version, the Type 763, is known as the Sahara, and 15 of these were ordered in 1956.

Powerplant: Four Pratt & Whitney R-2800-CA18s driving Hamilton Standard propellers.

Data appeared in *Flight* for November 20, 1959, page 583.

Breguet 940 Integral A STOL research machine built to French Government contract, the Integral first flew on May 21, 1958. Its trials have substantiated Breguet's belief that good cruising speed and carrying capacity are aerodynamically reconcilable with STOL capabilities without the need for a rotor. The basic concept is the "vectored slipstream": four big interconnected propellers blow across the whole span of a normally loaded wing which is generously endowed with full-span double-slotted flaps. Powerplant consists of four Turboméca Turmo II turboprops of 400 h.p. each. Gross weight is 16,000lb.

Flight reference: May 30, 1958.

Breguet 941 and 942 These two aircraft differ only in their fuselages, the 941 being unpressurized, and the 942 having a circular-section pressurized fuselage. The military 941 was built to Government contract, and flew on June 1, 1961, powered by four Turboméca Turmo IIID turboprops. Originally it was planned to install four de Havilland (General Electric T58 licence) Gnome turboprops of 1,250 s.h.p.: this installation is now offered as an alternative for both the 941 and 942. Consumption of the two engines is said by the manufacturer to be equivalent, so that performance figures are the same for both the 941 and 942. The Gnome installation, being lighter, allows a payload bonus of 450lb.

The 941 and 942 are of course developed from the 940 research vehicle, benefiting from all the successful flight testing so far achieved, and they fill a unique requirement for very-short-field (800-1,500ft) performance—allowing, for the first time, a fixed-wing vehicle with relatively low operating cost to compete with the helicopter in the city centre-city centre air transport business. Air Inter is considering an order for 942s.

Basic price: Quoted by an unofficial American source at about £250,000 for the 941.

The following data apply to the commercial Breguet 942:—

Powerplant: Four Turboméca Turmo IIID turboprops of 1,250 s.h.p. each driving Breguet Ratier 14ft 9in reversing propellers.

Dimensions: Span, 76ft 1in; length 76ft 9¼in; height, 31ft 8in; wing area, 887 sq ft.

Weights: Max take-off, 44,000lb; max payload, 12,350lb (13,900lb for the 941 freighter version); max landing weight, 40,000lb; zero-fuel weight, 39,300lb; weight less fuel and payload, 26,950lb.

Payload accommodation: Cabin volume, 2,100 cu ft; baggage and freight volume, 350 cu ft; cabin length, 30ft 8in; max internal width, 9ft 7in; max height, 6ft 6in; max usable floor area, 286 sq ft; dimensions of largest door, 59in × 71in; max number of seats, 50 five-abreast at 35in pitch.

Fuel capacity: 1,610 Imp gal (1,940 US gal).

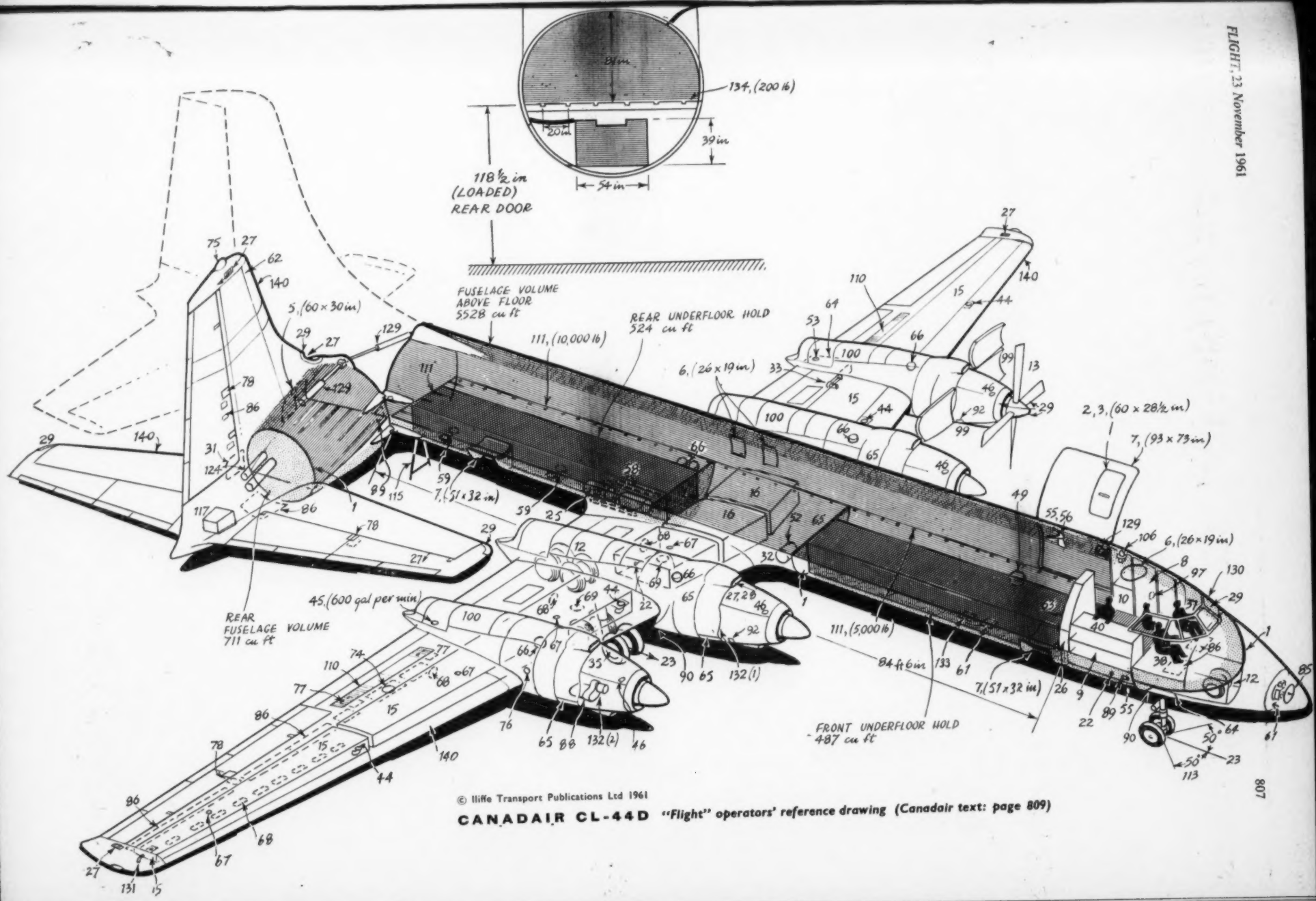
Performance: Opt-cost cruising speed at 1,500ft and 40,000lb, 216kt (248 m.p.h.); corres specific fuel consumption, 0.11; take-off distance to clear 35ft, ISA, SL (one engine failure, grass surface, max take-off weight), 1,440ft; typical take-off run, concrete surface, max take-off weight, 625ft; CAR landing field length (ISA, SL, concrete surface, 1.6 factor, max landing weight), 1,345ft; typical landing run, concrete surface, max landing weight, 395ft; range A (max payload), 750 n.m. (860 st.m.); range B (max fuel), 1,420 n.m. (1,630 st.m.); corres range B payload, 4,000lb.

Breguet 945 A smaller version of the Breguet 942 is under study, primarily for military use, for operation from 1,000ft hot and high-altitude airstrips. Designated Breguet 945, it would weigh about 20,000lb and be powered by two Turboméca Turmo IIIDs. Payload of about 3,300lb could be carried for more than 900 miles at almost 240 m.p.h.

BRISTOL *Bristol Aircraft Ltd, Filton House, Bristol, England (Member of the British Aircraft Corporation).*

Bristol 170 Freighter The prototype Bristol Freighter first flew on December 2, 1945, and was originally offered in two main versions; the Freighter with nose loading doors, and the Wayfarer all-passenger version without nose doors. Initial 170s had a span of 98ft and square tips, but the Freighter Mks 21, 21A and 21E and Wayfarer 22A of

One of Canadian Pacific Air Lines' six Britannia 314s


134, (200 lb)
20 in
39 in
54 in
118½ in (LOADED) REAR DOOR
FUSELAGE VOLUME ABOVE FLOOR 5528 cu ft
REAR UNDERFLOOR HOLD 524 cu ft
111, (10,000 lb)
6, (26 × 19 in)
5, (60 × 30 in)
7, (51 × 32 in)
2, 3, (60 × 28½ in)
7, (93 × 73 in)
45, (600 gal per min)
REAR FUSELAGE VOLUME 711 cu ft
111, (5,000 lb)
84 ft 6 in
FRONT UNDERFLOOR HOLD 487 cu ft

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CANADAIR CL-44D "Flight" operators' reference drawing (Canadair text: page 809)

The BAC One-Eleven, seen here in Braniff livery, is arousing keen interest among several US carriers

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1948 had a 10ft increase in span and a max weight of 40,000lb; the engines were two 1,700 b.h.p. Bristol Hercules 672s. The Freighter 31 and 31E have increased power (Bristol Hercules 734 of 2,050 h.p.) and take-off weight (44,000lb), together with a dorsal fin, while the Mk 32, designed for Silver City, has a 5ft 4in longer nose to accommodate three small cars instead of two. A total of 214 Bristol 170s were built for civil and military operators; about 60 are in service with 18 carriers. **Mk 21** All-freight version with flight deck only soundproofed. **Mk 21A** "Mixed" version, 16-20 passengers and freight. **Mk 21E** "Mixed" version with movable bulkhead. Entire cabin soundproofed. **Mk 22A** Passenger version seating 32-36. No nose doors. **Mk 31** As Mk 21. **Mk 31E** As Mk 21E. **Mk 32** With accommodation for two to three cars and up to 23 passengers.

Bristol Freighter Mks 31 and 32

Powerplant: Two Bristol Siddeley Hercules 734 piston engines of 2,050 h.p. each driving D.H. 14ft propellers.

Dimensions: Span, 108ft; length, 68ft 4in (Mk 31), 73ft 8in (Mk 32); height, 24ft; wing area, 1,487 sq ft.

Weights: Max take-off 44,000lb; landing, 44,000lb; capacity payload, 14,400lb (Mk 31), 12,000lb (Mk 32); weight less fuel and payload, 28,084lb (Mk 31), 30,553lb (Mk 32).

Payload accommodation: Cabin volume, 2,360 cu ft (Mk 31), 2,900 cu ft (Mk 32); cabin length, 49ft (Mk 31), 57ft 2in (Mk 32); max width, 8ft; max height, 6ft 7½in; nose door, 6ft 8½in × 6ft 7½in.

Fuel capacity: 1,172 Imp gal.

Performance: Cont cruise speed, 166kt (191 m.p.h.) at 10,000ft at 44,000lb; corres fuel consumption, 1.3 st.m.p.g.; balanced field length, max take-off weight, SL, ISA, 3,700ft; SL, ISA + 15°C, 4,100ft; 5,000ft, ISA, 4,800ft; landing distance from 50ft, 2,280ft; range A (max payload), 695 n.m. (800 st.m.); range B (max fuel), 1,610 n.m. (1,850 st.m.); corres payload, 5,000lb; corres speed, 143kt.

Britannia 100 First of the Britannia family of big turboprop airliners, powered by Proteus 705 turboprops and seating up to 92 passengers, the 100 was produced exclusively for BOAC. The prototype 100, G-ALBO, first flew on August 16, 1952. Fifteen, designated 102, were built for the Corporation from 1954-56, production being subsequently concentrated on the larger and more powerful 250/300/310/320 series described below. The 102 inaugurated the first Britannia services on February 1, 1957. Price paid by BOAC (fixed in April 1955) was £768,000 per aircraft.

Powerplant: Four Bristol Siddeley Proteus 705 turboprops of 3,900 e.h.p. each driving D.H. four-bladed, 16ft propellers.

Dimensions: As for 320, except length, 114ft, and height, 36ft 8in.

Weights: Max take-off, 155,000lb; landing, 125,000lb; zero fuel, 113,000lb; capacity payload, 25,000lb; weight less fuel and payload, 88,000lb.

Payload accommodation: Cabin volume, 5,150 cu ft; baggage and freight volume, 750 cu ft; cabin length (incl pantry and lavatory), 76ft; max width, 11ft 7in; max height, 6ft 8in; max usable floor area, 810 sq ft; dimensions of largest doors, 70in × 31.5in.

Fuel capacity: 6,690 Imp gal (8,034 US gal).

Performance: Cont cruising speed, 315kt (362 m.p.h.) at 20,250ft and 135,000lb; corres specific fuel consumption, 0.647lb/b.h.p./hr; balanced field length at max take-off weight, SL, ISA, 6,320ft; at SL, ISA + 15°C, 7,350ft; at 5,000ft, ISA, 8,020ft; landing distance from 50ft, 5,200ft; range A (max payload), 2,945 n.m. (3,385 st.m.); range B (max fuel), optimum cruise, 3,690 n.m. (4,250 st.m.); corres payload, 13,480lb; corres cruising speed, 285kt (328 m.p.h.).

Britannia 250 This is the generic type-designation of the military version of the Britannia, 23 of which have been delivered to RAF Transport Command by Bristol, and by Short Brothers & Harland from the assembly line operated at Belfast since December 1953.

Britannia 252 This is a passenger-cargo version, three of which were ordered for Government trooping work by the Ministry of Aviation for operation by British independent airlines. In the spring of 1959, as a result of a change in policy, these aircraft were transferred to RAF Transport Command. Maximum payload is 28,000lb, including 84 passengers and freight which is accommodated on the forward strengthened portion of the floor, and loaded via an enlarged door.

Powerplant: As for 320.

Britannia 253 This is essentially an all-cargo transport, built entirely to military requirements. Twenty have been delivered to RAF Transport Command. A special feature is the heavy "floating" floor designed by Shorts. The forward freight door has the same dimensions as that of the 252. Max payload is 34,000lb.

Powerplant: As for 320, except that the military designation of the Proteus 765 with water injection is 255.

Weights and performance data: p. 586 *Flight*, November 20, 1959.

Britannia 300 Three of these were built, one for the Ministry and two, designed 302, which were bought by Aeronaves de Mexico. The 300 has the capacity and power of the 305, but less tankage—6,690 Imp gal instead of 8,580 Imp gal and a max take-off weight of 170,000lb.

Britannia 305 A total of five of this model were built; two are in service with British United Airways (307), two with Transcontinental (308), and one with Ghana Airways (309). They are in all major respects comparable with the 310 model, the designation 305 being applied when, in 300 form, they were modified to bring them as closely as possible to 310 standard, including in particular the addition of the 310 wing with 8,580 Imp gal.

Britannia 310 This is the standard long-range version as operated by BOAC (15 312s); El Al (four 313s); CPAL (six 314s); British United Airways (two 317s, and two 312s leased from BOAC); Cubana (three 318s); Cunard Eagle (one 318 leased from Cubana, two 324, ex-CPAL); Ghana Airways (one 319).

The 310, first of which was flown on December 31, 1956, entered service across the North Atlantic with BOAC on December 19, 1958.

All data as for 320, except: capacity payload, 34,900lb; weight less fuel and payload, 93,100lb, and range B payload, 23,500lb.

Britannia 320 This was the standard production commercial Britannia until production ceased in 1959. It is a development of the 310 incorporating numerous detail engineering improvements. Of six built, two have been bought by Canadian Pacific Airlines and sold to Cunard Eagle. Basic price new was £1.07m.

Powerplant: Four Bristol Siddeley Proteus 765 turboprops of 4,450 e.h.p. driving de Havilland Hydromatic four-blade 16ft propellers.

Dimensions: Span, 142ft 3.5in; length, 124ft 3in; height, 37ft 6in; wing area, 2,075 sq ft; aspect ratio, 9.76.

Weights: Max take-off, 185,000lb; landing, 137,000lb; zero fuel, 128,000lb; capacity payload (ZFW-limited), 34,369lb; weight less fuel and payload, 93,631lb.

Payload accommodation: Cabin volume, 5,877 cu ft; baggage and freight volume, 910 cu ft; cabin length, 86ft 3in; max width, 11ft 7in; max height, 6ft 8in; max usable floor area, 883 sq ft; dimensions of largest door(s), 70in × 31.5in; max seats, 149.

Fuel capacity: 8,580 Imp gal (10,300 US gal).

Performance: Cont cruising speed, 345kt (385 m.p.h.) at 22,000ft and 150,000lb; corres specific fuel consumption, 0.585lb/b.h.p./hr; balanced field length at max take-off weight, SL, ISA, 8,150ft; at SL, ISA + 15°C, 9,600ft; at 5,000ft ISA, 11,800ft; landing distance from 50ft, 6,000ft; range A (max payload), 3,620 n.m. (4,160 st.m.); range B (max fuel), optimum cruise, 4,530 n.m. (5,000 st.m.); corres payload, 23,000lb; corres cruise speed, 310kt (357 m.p.h.).

Bristol 198 This is the project number given to the supersonic transport project that was developed by the British Aircraft Corporation, designated BAC-198, in close association with Sud-Aviation.

One projected variant is a light-alloy M2.2 transport seating 100/120 passengers, and capable of a 3,500 n.m. stage length. Geometry would be ogival narrow-delta, and one possible powerplant six Bristol Siddeley Olympus with reheat. It is possible that the project will be dropped in favour of joint Sud-BAC development of two versions of the Super Caravelle.

BRITISH AIRCRAFT CORPORATION *100 Pall Mall, London SW1.*

Manufacturers of commercial aircraft in the British Aircraft Corporation are Vickers-Armstrongs (Aircraft), Bristol Aircraft and Hunting Aircraft. Vickers' products appear under the heading Vickers, and Bristol Aircraft's products appear under Bristol.

BAC-107 This is a lighter variant of the BAC One-Eleven, shorter in length (by two seat-rows), and powered by two Bristol Siddeley BS.75 turbofans. It is a project only.

BAC One-Eleven Summed up briefly, the BAC One-Eleven is a jet replacement for the Viscount, similar in size, having the same fuel consumption (as the 810), but cruising 200 m.p.h. faster. The project can be traced back to the Hunting H.107, first design study of which was completed in May 1956. When, during 1960, Hunting became a member of the British Aircraft Corporation, Vickers and Hunting together redesigned the H.107—around two BS.75 turbofans at first, and, in its final form, around two Rolls-Royce Speys. The designation BAC One-Eleven was given in March 1961 and the decision to go ahead with an initial batch of 20 aircraft was made in April 1961 on the strength of an order—formally announced on May 9—for ten aircraft with an option on five from British United Airways. In October 1961 a firm order for six with an option on a further six was placed by Braniff Airways. Other US airlines who have stated their interest in the aircraft are Continental, Ozark and Frontier. First flight of the One-Eleven is scheduled for the second quarter of 1963 and target date for airworthiness certification is mid-1964 with deliveries to BUA starting in September 1964. The project is the first to be tackled by the British Aircraft Corporation as a unified company. A full description of the aircraft appeared in *Flight* for August 10, 1961, pages 182-186. Basic price, fixed until mid-1965, is £835,000 including seats. The data below are for the standard aircraft and for an optional variant having increased max take-off weight.

Powerplant: Two Rolls-Royce RB.163-1 Speys of 10,400lb thrust.

Dimensions: Span, 88ft 6in; length, 92ft 1in; height, 23ft 9in; wing area 980 sq ft; sweepback at quarter chord, 20°.

Weights: Max take-off, 68,250lb; max landing, 65,000lb; zero fuel, 50,000lb; typical max payload, 14,000lb; weight less fuel, crew and payload, 42,630lb.

Payload accommodation: Cabin volume, 3,150 cu ft; baggage and freight volume, 534 cu ft; cabin length, 55ft; max internal width, 10ft 4in; max height, 6ft 6in; max usable floor area, 507 sq ft; dimensions of largest door, 84in × 36in (ventral entry); max seats, 69 at 36in pitch.

Fuel capacity: 2,200 Imp gal (plus optional centre-section fuel tank of 850 Imp gal capacity).

[*Continued on page 809*

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Know your airports . . . 2

WHAT'S DOING AT MANCHESTER?

Why is Manchester so proud of its Airport?

Owned by the Manchester Corporation, it is the largest municipal aerodrome in Great Britain, linking the city and its surroundings—which, within a radius of fifty miles, embrace the most heavily industrialised area in the world—with more than fifty cities and towns in North America, Europe and the United Kingdom. Manchester Airport is a first-class example of municipal enterprise on an international scale.

How long has it been Corporation-controlled?

Since it was first opened on June 25, 1938. After the war the Ministry of Civil Aviation intended to purchase the Airport but Manchester Corporation considered that it was better suited to understand and further the aeronautical aspirations of the area. This opinion was backed by years of experience in operating a municipal airport, first at Wythenshawe in 1929, then at Barton and finally at Ringway, the present location. The Corporation won its point.

What about current development?

The main runway has been extended and construction of the magnificent new terminal which began in October 1957 is due for completion soon, as is the installation of an Esso hydrant refuelling system. This will be the first major development of its kind in the United Kingdom.

Why have hydrant refuelling?

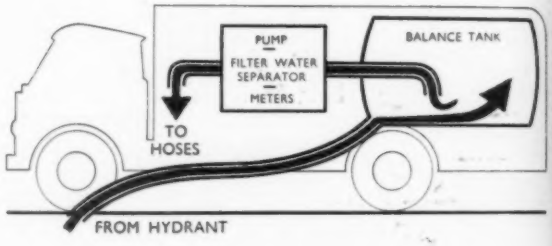
Thirsty jet airliners with a vast capacity for fuel; apron space at a premium as traffic increases; and the constant demand for quick turn-round which is the secret of economy. All these factors contribute to the pressing need for safe, efficient fuel service fast, however great the requirement. One of the answers is hydrant refuelling. And at Manchester Airport, the fact that it handles a considerable proportion of transit traffic, coupled with the compact design of the new terminal area makes hydrant refuelling the ideal choice.

What's all this excavation work?

The photograph shows part of the pipelines of the hydrant system at Manchester and the site of the shock-alleviating chambers—essential items in this kind of system to cope with the problem of hydraulic shock. At Manchester the function of these units is supplemented by the use of Hydrafuellers—an Esso invention which will ensure that the hydrant system at this Airport will set a new standard for safety and efficiency in operation and economy in installation.

And just what is a Hydrafueller?

Esso's new Hydrafueller is a servicing vehicle which consists principally of a balance tank with a pump, filters, bypass valves and fuelling hoses. The diagram shows how it works.



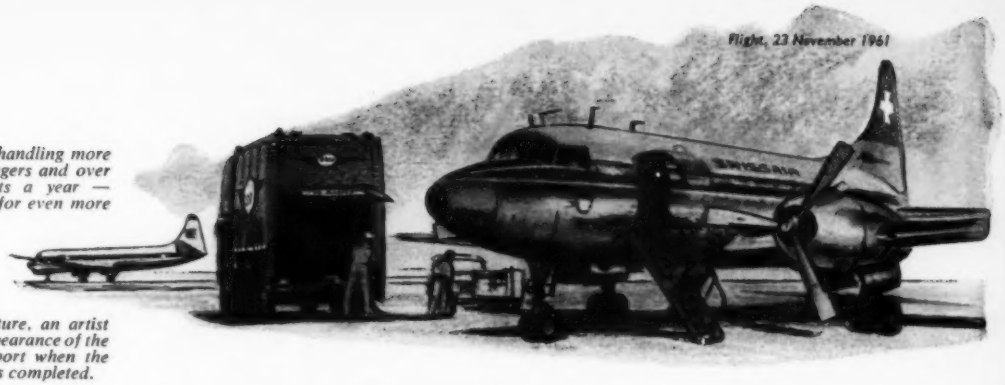
Fuel from the hydrant flows into the balance tank at a rate governed by the hydrant pumps and controlled by the float and slow-closing valve. The pump on the vehicle takes its suction from the tank and delivers fuel to the aircraft through a short length of hose. Thus the Hydrafueller completely isolates the aircraft from the risk of hydraulic shock from the hydrant line. This is but one example of Esso's original thinking—keeping an eye on the future as well as meeting current demands.

What are the prospects at Manchester?

The passenger and freight potential in the area served by the Airport is enormous. Within a fifty-mile radius there are all the cotton-manufacturing towns, the whole of the Yorkshire woollen district, the Potteries, Sheffield, Liverpool and part of the manufacturing area round Derby. Manchester is determined to match this impressive air traffic potential by airport services which will compare favourably with those provided by any other major airport in the world. And in this bold endeavour Esso is equally determined to play its full part. In the future as in the past it will continue to provide safe, swift fuel service at Manchester of a standard that is second to none.

Esso Petroleum Company Limited
Aviation Department
36 Queen Anne's Gate, London S.W.1
Telephone: HYDe Park 7030

Already a busy airport — handling more than half a million passengers and over 32,000 aircraft movements a year — Manchester is gearing up for even more business.



Looking into the near future, an artist emphasises the "clean" appearance of the apron at Manchester Airport when the hydrant fuelling system is completed.

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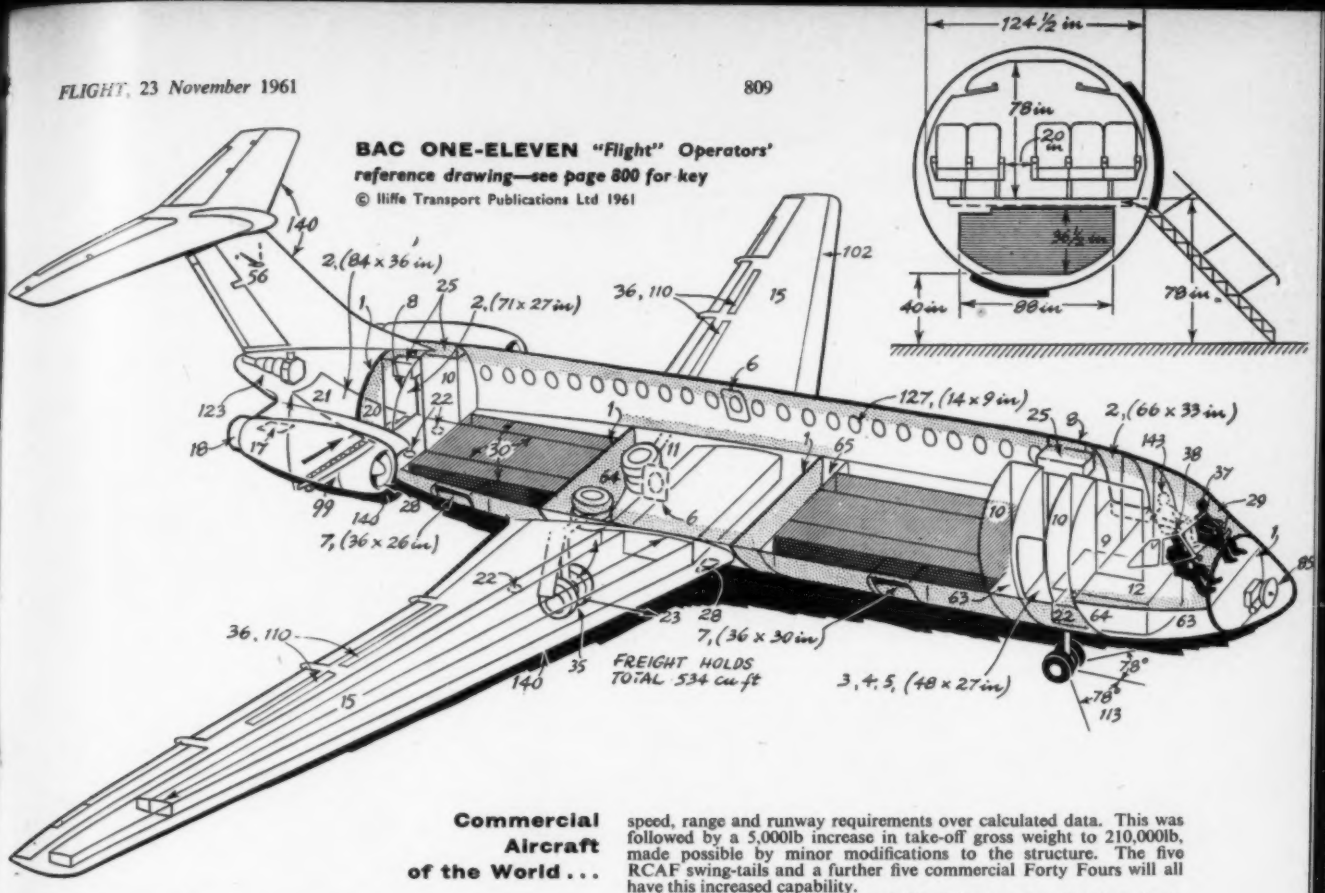

Commercial Aircraft of the World . . .

Performance: Opt-cost (i.e., typical) cruising speed, 469kt TAS at 25,000ft and 65,000lb; corres specific fuel consumption, 0.0877 n.m./lb; take-off field length, ISA, SL, max take-off weight to 35ft (effective field length), 5,250ft; landing field length, ISA, SL, max landing weight from 50ft (60 per cent factor) 5,800ft; range A (max payload), including allowances for air and ground manœuvre, 1,060 n.m.; range B (max fuel), with allowances for air and ground manœuvre, 1,840 n.m. with 7,700lb payload (optional extra tankage increases range B to 2,665 n.m. with 920lb); cruise Mach number, over 24,100ft, 0.78; Vc up to 24,100ft, 320kt EAS; VNO, as Vc; VSO, max landing weight, 92kt.

BAC One-Eleven. Optional variant Details as for the standard One-Eleven except:

Weights: Max take-off, 73,500lb; zero fuel, 58,000lb; weight less fuel and payload, 42,690lb.

Performance: Opt-cost (i.e., typical) cruising speed at 25,000ft and 67,000lb, 469kt TAS; corres specific fuel consumption, 0.087 n.m./lb; take-off field length, ISA, SL, max take-off weight to 35ft (effective field length), 6,300ft; range A (max payload) with fuel allowances for air and ground manœuvres, 1,610 n.m.; range B (max fuel) with similar fuel allowances, 1,784 n.m. with 12,700lb payload (optional tankage increases range B to 2,588 n.m. with 6,150lb of payload).

CANADAIR *Canadair Ltd, Post Office Box 6087, Montreal, Canada.*

DC-4M A pressurized, Merlin-engine development of the Douglas DC-4/C-54, the DC-4M was named North Star by TCA, who operated it from 1947 until last summer. The DC-4M was bought also by BOAC in March 1949; they named it Argonaut, but none remains in corporation service. The only operators at present are EAAC (three ex-BOAC); the Rhodesian Air Force (four ex-BOAC); and Flying Enterprise (two ex-BOAC). Overseas Aviation also operated ex-BOAC and ex-TCA DC-4Ms; these are now up for sale by Airline Air Spares Ltd.

Powerplant: Four Rolls-Royce Merlin Mk 626 of 1,760 b.h.p. driving Hamilton Standard 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 93ft 7¼in; height, 27ft 6in; wing area, 1,457 sq ft.

Weights: Max take-off, 82,300lb; landing, 70,000lb; zero fuel, 66,000lb; capacity payload, 17,156lb; weight less fuel and payload, 46,728lb.

Payload accommodation: Max seats, 55; baggage and freight volume, 698 cu ft.

Fuel capacity: 3,226 Imp gal (3,870 US gal).

Performance: Cont cruising speed 280 m.p.h. at 10,000ft and 70,000lb; range A (max payload), 2,075 n.m. (2,385 st.m.); range B (max fuel), 3,240 n.m. (3,730 st.m.).

CL-44D-4 First flight of the swing-tail Canadair Forty Four was on November 16, 1960, and FAA type-certification was issued on June 29, 1961. Flying Tiger (ten) and Seaboard World (five) both started operations in July, and Slick (two) will soon follow suit. An RCAF CC-106 Yukon made its first transatlantic flight in August and the Service is to receive five swing-tails in addition to 12 side-loading Yukons.

Flight testing of the Forty Four resulted in measured improvements in speed, range and runway requirements over calculated data. This was followed by a 5,000lb increase in take-off gross weight to 210,000lb, made possible by minor modifications to the structure. The five RCAF swing-tails and a further five commercial Forty Fours will all have this increased capability.

The Rolls-Royce Tyne-powered CL-44 has an exceptional payload-range performance and is claimed to have a lower operating cost per ton-mile than any other freighter in service or on order. The swing-tail allows rapid loading of an item 11ft wide, 6½ft high, 84ft long and weighing 65,000lb. The practicability of loading two complete F-104 airframes and engines through the swing-tail was proved at Montreal in July and this unique means of rapid airlift from the US West Coast to Western Germany was demonstrated a few weeks later.

Powerplant: Four Rolls-Royce Tyne 12 Mk 515 turboprops of 5,730 e.h.p. each driving de Havilland 16ft four-bladed propellers.

Dimensions: Span, 144ft 3.6in; length, 136ft 9.9in; height empty, 38ft 7.7in; wing area, 2,075 sq ft.

Weights: Max take-off, 210,000lb; max landing, 165,000lb; zero fuel, 155,000lb; capacity payload (domestic), 64,915lb; weight less fuel, crew and payload, 89,485lb domestic, 90,420lb international.

Payload accommodation: Main cabin volume, 6,239 cu ft; baggage and freight volume (under floor), 1,109 cu ft; cabin accommodational length, 84ft 6in; max internal width, 11ft 5in; max height, 6ft 9½in; max usable floor area less flight deck, 1,387 sq ft; cross sectional loading, 137in × 81½in; max number of seats with galleys, 189 at 28in pitch.

Fuel capacity: Domestic, 8,458 Imp gal (10,157 US gal); international, 10,108 Imp gal (12,140 US gal).

Performance: Opt-cost (i.e., typical) cruising speed at 20,000ft and 165,000lb, 349kt; corres s.f.c., 0.41lb per t.e.h.p. per hour; take-off field length at 210,000lb CAR, ISA, SL, 7,350ft; landing field length, 165,000lb CAR, ISA, SL, 5,980ft; range A (max payload), 3,550 n.m.; range B (max fuel), 5,680 n.m. with 37,440lb; cruise Mach number, 0.62; VNE at 155,000lb ZFW, 309kt IAS; VNO at 155,000lb ZFW, 276kt IAS; VSO at max landing weight, 95kt IAS.

Basic price: £1,407,000.

Operators' drawing of CL-44D: page 807.

Canadair 540 This is the new production 540 built by Canadair at Montreal on Convair 440 jigs. The aircraft may be powered by either Napier Eland (**540**) or Allison (**540A**) turboprop engines.

By increasing internal cabin length, standard accommodation for 52 first-class seats instead of 44 is available. Engineering improvements include better braking, increased fuel capacity and faster undercarriage retraction. Recent developments include seating configurations with up to 83 passengers at a 28in pitch and non-reclining seats.

Two 52-seater Eland-powered Canadair 540s (CL-66A) were sold to Quebecair in August 1960, fitted with an APU in the tail. This provides

The Canadair CL-44D-4. Its swing tail sets a new fashion for freighters

Swissair is operating two Convair 880Ms leased from Convair on Far East routes pending delivery of its Convair 990s, due to start this month

d.c. current and a 74°F cabin temperature irrespective of OAT. Ten Eland-powered 540s are in service with the RCAF as the CC-109 Cosmopolitan (CL-66B).

Conversion to Allison engines can be done in 90 days at a cost of about $600,000. This includes changes to the nacelle and wing structure, a fin extended by 1ft, larger-area rudder, a 40in increase in tailplane span and 17 sq ft increase elevator area, larger tabs, and re-arranged cockpit instruments and controls.

Canadair 540A

Powerplant: Two Allison 501-D13 turboprops of 3,750 e.h.p. each driving 13ft 6in Aeroproducts 606 propellers.

Dimensions: As Convair 340/440.

Weights: Max take-off, 53,200lb; landing, 50,670lb; zero fuel, 45,000lb; capacity payload, 11,530lb; weight less fuel and payload, 33,470lb.

Payload accommodation: As Convair 340/440.

Fuel capacity: 1,440 Imp gal (1,730 US gal).

Performance: Typical cruise speed, 304kt (350 m.p.h.) at 20,000ft and 48,000lb; corres specific fuel consumption, 0.484; balanced field length, max take-off weight, sea level, ISA, 4,140ft; sea level, ISA + 15°C, 4,975ft; 5,000ft ISA, 5,650ft; landing distance from 50ft, 4,160ft; range A (max payload), 790 n.m. (910 st.m.); range B (max fuel), 1,610 n.m. (1,850 st.m.); corres payload, 8,000lb; corres cruise speed, 304kt (350 m.p.h.).

Convair 540 This is the designation given to a CV-340 or CV-440 converted to Napier Eland turboprop power. New production turboprop Convairs are known as Canadair 540s (*q.v.*).

So far, the only operator of Convair 540s is Allegheny Airlines. The first conversion was completed in 1955 at Luton and US certification was obtained on August 22, 1958. Nine 340s have also been bought by Napier for conversion as required. Allegheny commenced operations, at first on a trial basis, on July 1, 1959, have ordered four more Convair 540 conversions and bought 14 traded-in Convair 340/440s from Lockheed; seven of these are in service and four have been converted to 540 standard. Butler Aviation in Washington have modified the interiors to 52 seats and Eland conversions are undertaken by AiResearch.

Conversion cost is about £160,000.

Powerplant: Two Napier Eland 504A turboprops each producing 3,500 e.h.p. for take-off (at SL, ISA) and driving de Havilland 4BI four-blade, 13ft 6in diameter propellers.

Dimensions: Span, 105ft 4in; length, 79ft 2in (with radome, 81ft 6in); height, 28ft 2in; wing area, 920 sq ft.

Weights: Max take-off, 53,200lb; landing, 50,670lb; zero fuel, 47,000lb; capacity payload, 12,986lb; max space payload, 11,900lb; weight less fuel and payload, 34,014lb.

Payload accommodation: Cabin volume (less flight deck), 2,515 cu ft; baggage and freight volume, 402 cu ft; cabin length, 54ft 10in; max width, 8ft 11in; max height, 6ft 7in; max usable floor area (less flight deck), 396 sq ft; dimensions of largest doors, 36in × 83in; max seats, 70 at 30in pitch.

Fuel capacity: 1,690 Imp gal (2,032 US gal, or 2,580 US gal with optional bag tanks).

Performance: Typical cruising speed, 279kt (321 m.p.h.) at 20,000ft and 46,000lb; balanced field length, max take-off weight, SL, ISA, 4,550ft; landing distance from 50ft, 4,020ft; range A (max payload), 785 n.m. (905 st.m.); range B (max fuel), 1,800 n.m. (2,070 st.m.) at 279kt (322 m.p.h.) with 5,572lb payload; V_{NE}, 293kt EAS; V_{NO}, 260kt EAS; V_{SO}, 77kt EAS.

CHINESE STATE AIRCRAFT INDUSTRY

See under Peking.

CONVAIR

General Dynamics Corporation, San Diego 12, California, USA.

Consolidated PBY-5A (Catalina) About 56 of these amphibians—conversions of US Navy PBY-5s, RAF Catalinas and RCAF Cansos—are still in service, notably with Pacific Western, Panair do Brasil and TransAir (Canada). *Flight* reference: November 20, 1959.

Convair 240 The prototype CV-240 flew on March 16, 1947, and the first deliveries, to American Airlines, were made less than a year later; services started on June 1, 1948. The design achieved considerable success, and was ordered in quantity by American, Western, PanAm and Continental, and in Europe by KLM, Sabena and Swissair. Some 120 are still operational. The fuselage was pressurized and offered with either rear or fuselage-side passenger loading. Until June 1948, the basic price was less than £100,000. Used price today is about £40,000. *Flight* reference, including full data: November 20, 1959.

Powerplant: Two Pratt & Whitney R-2800-CA18 of 2,400 b.h.p. each for take-off driving Hamilton 13ft 1in propellers.

Convair 340 Direct successor to the Convair 240, the 340 has a longer fuselage, additional wing area, higher maximum weight and greater power. There were a number of other design improvements, including a new flap arrangement. The 340 is equipped with folding stairs in an entrance on the port, instead of the starboard side as on the 240. The first 340 contracts were signed early in 1951 and the prototype made its first flight on October 5, 1951. Over 200 were built for civil use and 190 are still operational with 20 airlines. *Flight* reference, including full data: November 20, 1959.

Powerplant: Two Pratt & Whitney R-2800-CB16/17 of 2,500 b.h.p. each driving Hamilton 13ft 6in propellers.

Convair 440 As was to be expected, the 340 gross weight did not long remain at 47,000lb, and in the CV-440 Metropolitan it reached 49,700lb. Soundproofing was considerably improved, and a new thrust-augmenting exhaust system, with its rectangular exit nozzle above the wing trailing edge, is a distinguishing feature of the 440. The first flight of this version was made on December 16, 1955. The majority of the 153 Metropolitans built are still in service, the principal operators being Eastern (20), REAL (14), Sabena (9), SAS (20) and Swissair (11). The aircraft was described in *Flight*, July 6, 1956. There have been few sales of used CV-440s in the past year and the current price is uncertain.

Powerplant: As 340.

Dimensions: As 340 except length, 81ft 6in (includes nose radar).

Weight: Max take-off, 49,000lb; landing, 47,650lb; zero fuel, 47,600lb; capacity payload, 14,200lb; weight less fuel and payload, 32,800lb.

Payload accommodation: As 340.

Fuel capacity: As 340.

Performance: Continuous cruising speed, 250kt (289 m.p.h.) at 20,000ft and 45,000lb; field length (CAR 4b Part 40), max take-off weight, SL, ISA, 5,680ft; landing distance from 50ft, 4,060ft; range A (max payload), 409 n.m. (470 st.m.) with 1,650lb reserve fuel; range B (max fuel), 1,635 n.m. (1,880 st.m.) with 1,650lb reserve fuel.

Convair 880 and 990 Convair flew their first CV-880 for the first time on January 27, 1959. Versions offered by Convair now are the basic **Convair 880 Model 22, Convair 880M,** and **Convair 990.** FAA certification of the 880 was granted on May 1, 1960, and services were started by Delta on May 15. Orders for Convair jet transports now total 96, as follows: *Model 22:* TWA, 20; Delta, 17; Northeast, 6; Hughes Tool Co, 4; *Model 22M:* Alaska, 1; Swissair, 2 (leased from Convair); VIASA, 2; Civil Air Transport, 1; JAL, 5; FAA, 1; *Convair 990:* American, 25; Swissair, 7 (2 for SAS); SAS, 2; Aerovias Brasil (ex-REAL), 3. Delivery of 990s has been deferred pending the recovery of performance deficiencies discovered during tests: Swissair now expects delivery starting this month and ending next February.

Operators' drawing of basic Convair 880: pages 812-813.

Convair 880 Model 22

Powerplant: Four General Electric CJ-805-3 turbojets of 11,200lb static thrust.

Dimensions: Span, 120ft; length, 129ft 4in; height empty, 36ft 4in; wing area, 2,000 sq ft; sweepback at quarter chord, 35°.

Weights: Max take-off, 184,500lb; max landing, 132,800lb; zero fuel, 117,000lb; capacity payload (first-class space limited), 23,150lb; weight less fuel and payload, 88,615lb.

Payload accommodation: Cabin volume (less flight deck), 4,750 cu ft; baggage and freight volume, 863 cu ft; cabin length, 89ft 3in; max internal width, 10ft 8in; max height, 7ft 1in; max usable floor area (less flight deck), 922 sq ft; dimensions of largest door, 74in × 30in; max seats, 144 at 34in pitch.

Fuel capacity: 8,896 Imp gal (10,684 US gal).

Performance: Typical cruising speed, 483kt (557 m.p.h.) TAS at 35,000ft and 150,000lb; corres consumption, 1,606 US gal/hr; balanced field length, max take-off weight, SL, ISA, 8,200ft; ISA + 15°C, 9,450ft; 5,000ft, ISA, 12,100ft; landing distance from 50ft, 6,180ft; range A (max payload), not stated; range B (max fuel), 3,530 n.m. (4,065 st.m.); cruise, M.89; V_{NE}, 380kt (438 m.p.h.) EAS; V_{NO}, 375kt (432 m.p.h.) EAS; V_{SO}, 110kt (127 m.p.h.) EAS.

Convair 880M This is a modified version (M stands for modified) of the Convair 880 Model 22, tailored for shorter ranges and to reduce turn-around time on the ground. It was announced in October 1959. Modifications include the addition of four leading-edge slats on each wing; power-boosted rudder and larger fin; provision for pre-loaded baggage bins; structural provision for 10,436 Imp gal fuel in three-bay centre-section tanks; CJ-805-3Bs of 450lb additional thrust each; strengthened undercarriage associated with greater max weight (191,000lb); retractable tail skid and an improved anti-skid braking system.

Convair 880M Model 22M

Powerplant: Four General Electric CJ-805-3B turbojets of 11,650lb static thrust.

Dimensions: As Model 22.

Weights: Max take-off, 191,000lb; max landing, 155,000lb; zero fuel, 121,500lb; capacity payload, 23,150lb.

Payload accommodation: As Model 22.

Fuel capacity: 10,436 Imp gal (12,534 US gal).

Performance: Optimum-cost cruise, 483kt (557 m.p.h.) TAS at 30,000ft and 150,000lb; corres fuel consumption, 1,526 US gal/hr;

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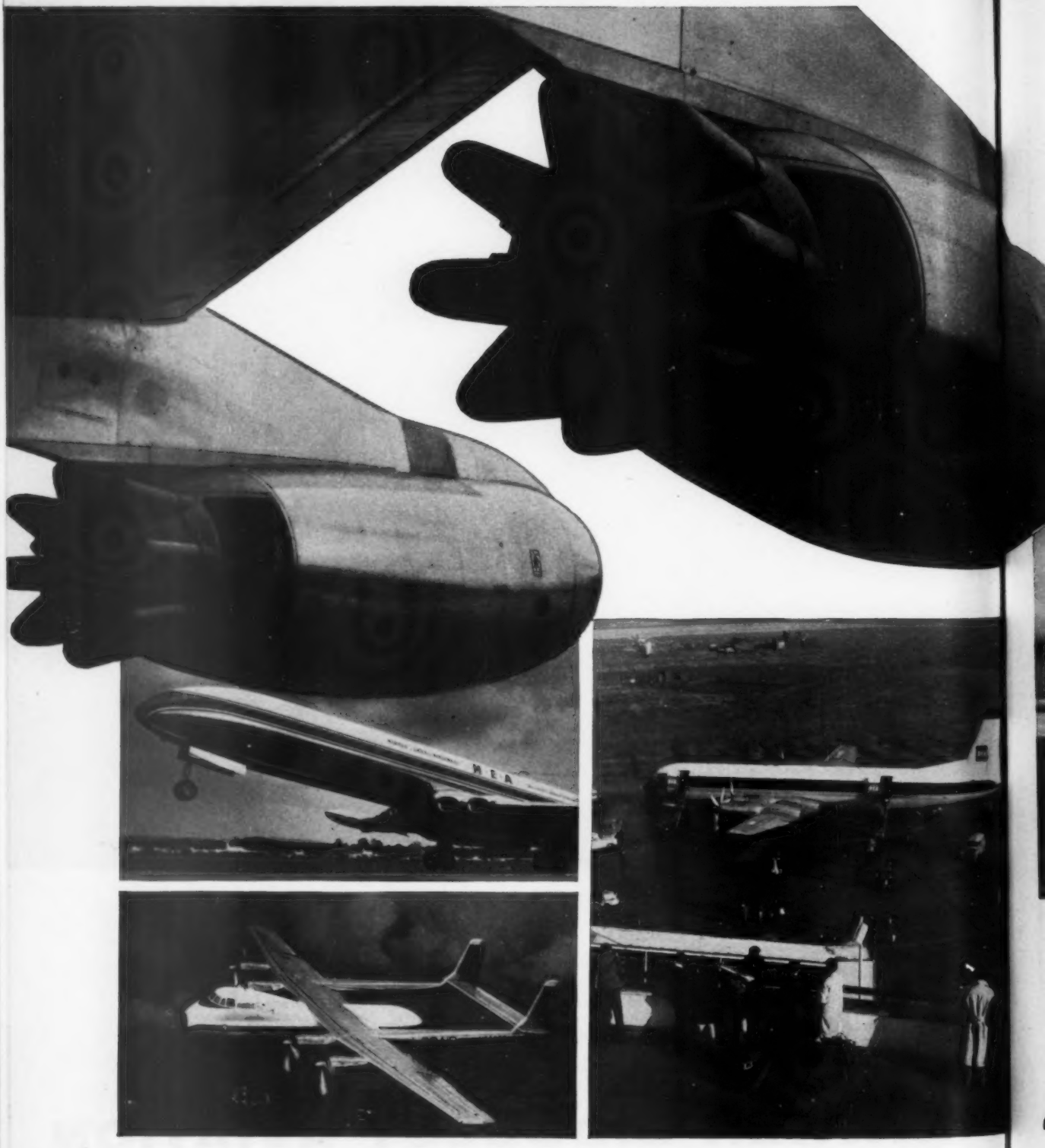

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AE.58

The intermediate-range Comet 4C combines the Mk 4B's longer fuselage with the Comet 4's wing and fuel tankage

Commercial Aircraft of the world . . .

range A (max payload), not stated; range B (max fuel), 4,390 n.m. (5,056 st.m.); corres payload, 16,787lb; cruise Mach, 0.89; VNE, VNO, as Model 22; VSO, 101kt (116 m.p.h.) EAS.

Convair 990 Largest, heaviest and fastest of the family, the 990 was designed to carry up to 139 passengers, to have US transcontinental range and to fly faster than any other commercial transport. Fuselage length was increased by 10ft, max weight raised to 244,200lb, and the aircraft area-ruled by the addition of substantial anti-shock bodies extending beyond the trailing edge of the wing (parts of these provide extra fuel storage). The claimed maximum cruising speed is Mach 0.91 (up to 625 m.p.h.). There are two models, the **Convair 990 Domestic** (as ordered by American Airlines) and the **Convair 990 International** (as ordered by SAS/Swissair). Flight tests have revealed a shortfall in speed performance, which it is hoped to recover in the course of current development work. Meanwhile deliveries have been delayed and customer contracts are being renegotiated.

American Airlines placed the first order for CV 990s, for 25 (with an additional 25 on option) to be delivered from June 1961. The SAS/Swissair consortium has ordered nine, giving the 990 the class name **Coronado.** The first 990 made its maiden flight in January 1961, and five aircraft are participating in the flight test programme. The following data are estimates prior to flight-tests; finalized figures, particularly in respect of speed performance, are not yet available.

Convair 990 Domestic

Powerplant: Four General Electric CJ-805-23 turbofans of 16,100lb static thrust.

Dimensions: Span, as Model 22; length, 139ft 2in; height empty, 39ft 6in; wing area, 2,250 sq ft; sweepback, 35°.

Weights: Max take-off, 239,200lb; max landing, 180,000lb; zero fuel, 154,000lb; capacity payload, 25,120lb; weight less fuel and payload, 115,833lb.

Payload accommodation: Cabin volume (less flight deck), 5,120 cu ft; baggage and freight volume, 928 cu ft; cabin length, 89ft 9in; max internal width, 10ft 8in; max height, 7ft 1in; max usable floor area (less flight deck), 1,022 sq ft; dimensions of largest door, 74in × 30in; max seats, 159 at 34in pitch.

Fuel capacity: 12,579 Imp gal (15,108 US gal).

Performance: Optimum-cost cruising speed, 496kt (571 m.p.h.) TAS at 35,000ft and 190,000lb; corres fuel consumption, 1,658 US gal/hr; balanced field length, max take-off weight, SL, ISA, 8,600ft; ISA+15° C, 9,800ft; 5,000ft, ISA, 13,100ft; range A (max payload), not stated; range B (max fuel), 4,741 n.m. (5,460 st.m.); cruise Mach, 0.91; VNE, 439kt (506 m.p.h.) EAS; VNO, 394kt (455 m.p.h.) EAS; VSO, 101kt (116 m.p.h.) EAS.

Convair 990 Intercontinental

Powerplant: As Domestic model.

Dimensions: As Domestic model.

Weights: Max take-off, 244,200lb; max landing, 180,000lb; zero fuel, 154,000lb; capacity payload, 27,893lb; weight less fuel and payload, 124,567lb.

Payload accommodation: As Domestic model.

Fuel capacity: 13,050 Imp gal (15,672 US gal).

Performance: As Domestic model except, range B (max fuel), 4,850 n.m. (5,585 st.m.); corres payload, 15,433lb.

CURTISS

CW-20/C-46 (Commando) The pressurized Curtiss CW-20 prototype first flew on March 26, 1940. It was later redesigned to have a single fin and rudder, and was taken over by the USAAF under the designation C-55. It was acquired by BOAC in 1941. Production for the airlines was forestalled by Pearl Harbor, but a total of 3,181 unpressurized military transport versions were built for the USAAF as the C-46 Commando, powered by Pratt & Whitney R-2800 Double Wasps. A post-war commercial version, the CW-20E, was planned but abandoned after Eastern Air Lines cancelled an order. But after 1945 many war-surplus C-46s were acquired by commercial operators, especially in North and Latin America, where 356 Commandos are now used by 91 carriers.

The CW-20T version (*Flight*, May 4, 1956), evolved by Air Carrier Engineering Services and the L. B. Smith Aircraft Corp of Miami, was awarded an unrestricted CAA certificate in 1956 as the result of some 30 engine and airframe improvements. In March 1958 L. B. Smith obtained approval at 50,100lb max weight for another modified version known as the Super 46C; in November 1958 this weight was increased to 50,650lb. Riddle Airlines, largest commercial operator of C-46s, produced a broadly similar conversion, the **C-46R,** which was awarded a transport-category certificate in March 1957 (*Flight*, November 28, 1958). Current second-hand market prices being asked range from about £20,000 for C-46F conversions to £60,000 for the C-46R.

C-46A, C-46D, C-46F

Powerplant: Two Pratt & Whitney R-2800-51M1 Double Wasps of 2,000 b.h.p. each driving Hamilton Standard 14ft 6in propellers.

Dimensions: Span, 108ft; length, 76ft 4in; height, 21ft 9in; wing area, 1,358 sq ft.

Weights: Max take-off, 48,000lb; landing 48,000lb; zero fuel, 47,130lb; capacity payload, 17,600lb; empty, 29,100lb.

Payload accommodation: Cabin volume, 2,300 cu ft; under-floor freight hold volume, 432 cu ft; cabin length, 48ft; max width, 9ft; max height, 6ft 8in; usable floor area 348 sq ft; largest door, 95½in × 78½in.

Fuel capacity: 1,406 US gal (1,170 Imp gal).

Performance: Cruising speed, 169kt (195 m.p.h.) at 9,000ft at 48,000lb and 950 b.h.p. per engine; corresponding fuel consumption, 150 gal/hr; balanced field length, 4,575ft at sea level, ISA; landing distance from 50ft, 2,240ft; max range, 1,560 n.m. (1,800 st.m.) at 169kt (195 m.p.h.) with 9,584lb payload.

DE HAVILLAND *The de Havilland Aircraft Co. Ltd, Hatfield, Herts. (Member of the Hawker Siddeley Group.)*

D.H.104 Dove 8 First flown on September 25, 1945, the Dove was marketed as an "airliner in miniature." Over 500 have been built—more than any other British transport—and 55 are currently in service with 27 airlines. The others are on light commercial, military and other duties or in private ownership.

The Dove 8—faster and longer-ranging with improved ejector exhaust Gipsy Queen 70s—is directed primarily at the executive market, with a luxurious interior for up to six passengers. In the USA, where cabin schemes are executed to customer requirements by a specialist firm, this new Dove is known as the **Dove Custom 800.** The deeper Heron canopy is fitted and the instrument panel and cockpit are restyled.

D.H.106 Comet 4 The Comet 4 stems from the Comet 1 which first flew on July 27, 1949, and which BOAC, UAT, and Air France operated from 1952-54. The Comet 4 is a revised version with more power, range and payload and incorporating the structural knowledge gained in the accidents of 1954. The first of 19 Comet 4s for BOAC made its initial flight on April 27, 1958, and BOAC inaugurated the first transatlantic jet services with these aircraft on October 4, 1958, following with Comet services to India, Hong Kong, Japan, Australia and South America. The corporation withdrew Comet 4s from the North Atlantic route on October 16, 1960. Aerolineas Argentinas operates Comet 4s from Buenos Aires to Santiago de Chile, New York and to points in Europe. Two more Comet 4s have been delivered to East African Airways Corporation.

Powerplant: Four Rolls-Royce Avon 524 RA.29/1 turbojets of 10,500lb thrust each.

Dimensions: Span, 115ft; length, 111ft 6in; height, 29ft 6in; wing area, 2,121 sq ft.

Weights: Max take-off, 162,000lb; landing, 120,000lb; zero fuel, 99,000lb; capacity payload (81-seat tourist-class), 20,286lb; weight less fuel and payload (81-seat tourist-class), 75,424lb.

Payload accommodation: Cabin volume, 2,815 cu ft; baggage and freight volume, 570 cu ft; cabin length, 71ft 8in; max width, 9ft 7in; max height, 6ft 6½in; usable floor area, 439 sq ft; entrance door dimensions, 56in × 30in; max seats, 81 at 34in pitch.

Fuel capacity: 8,898 Imp gal.

Performance: Opt-cost cruising speed, 438kt (505 m.p.h.) at 28,000ft and 130,000lb with fuel consumption of 9,650lb/hr; balanced field length, max take-off weight, sea level, ISA, 6,750ft; landing field length, max landing weight, sea level, ISA, 6,630ft; range A (max payload), 3,500 n.m. (4,030 st.m.) (81-seat tourist); range B (max fuel), 3,820 n.m. with 15,476lb; cruise M.74; VNE, 300kt (345 m.p.h.) IAS; VNO, 290kt (334 m.p.h.) IAS; VSO, 94kt (108 m.p.h.) at 115,000lb.

D.H.106 Comet 4B The Comet 4B was evolved to BEA's requirements for a "first-generation" jet. Fourteen 4Bs have been ordered by BEA and four by Olympic Airways. Main difference compared with the Comet 4 is a 6ft 6in longer fuselage seating up to 102 passengers. To allow higher cruising speeds at lower altitudes, wing span is reduced by 7ft 2in, and the Comet 4B's medium-range role enables the pod-type wing tanks to be deleted. BEA's initial contract for six was valued at "about £7m" with spares.

Powerplant: Four Rolls-Royce Avon 525B RA.29/1 turbojets of 10,500lb static thrust each.

Dimensions: Span, 107ft 10in; length, 118ft; height, 29ft 6in; wing area, 2,059 sq ft.

Weights: Max take-off, 158,000lb; landing, 120,000lb; zero fuel, 102,500lb; capacity payload, 24,137lb; weight less fuel and payload, 78,363lb.

Payload accommodation: Cabin volume, 3,160 cu ft; baggage and freight volume, 640 cu ft; cabin length, 78ft 2in; max width, 9ft 7in;

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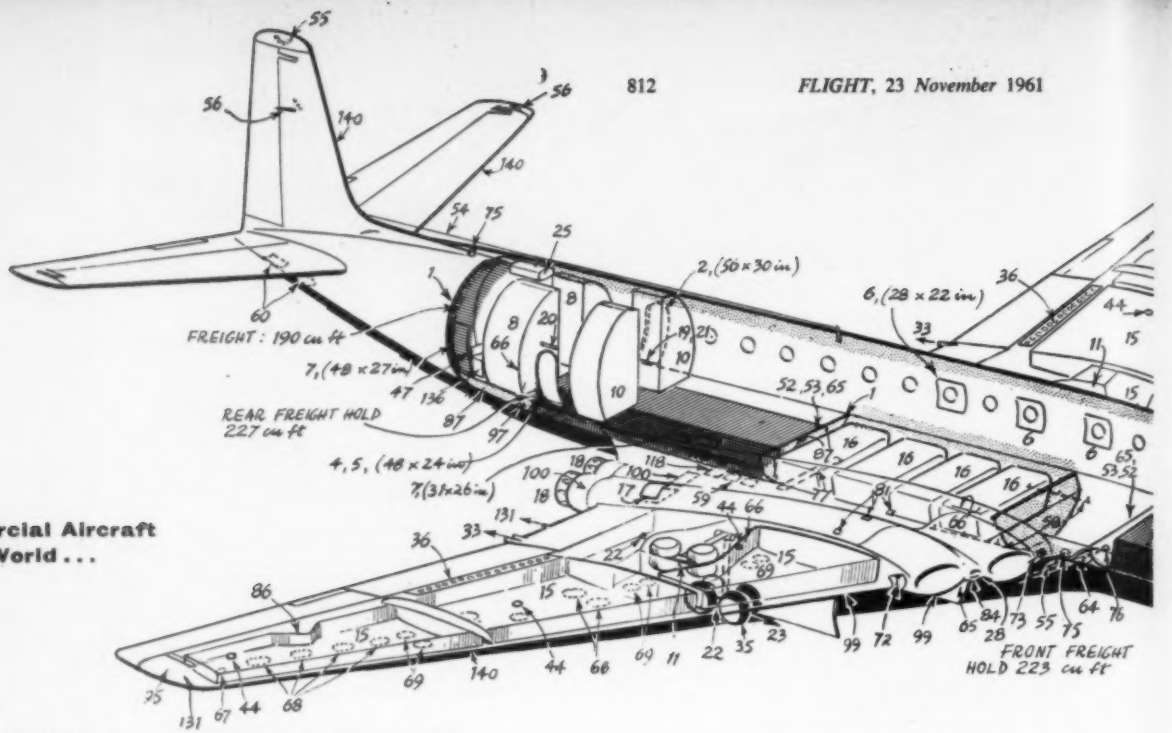

FREIGHT : 190 cu ft
REAR FREIGHT HOLD 227 cu ft
FRONT FREIGHT HOLD 223 cu ft
2,(50 x 30 in)
6,(28 x 22 in)
7,(48 x 27 in)
4,5,(48 x 24 in)
7(31 x 26 in)

max height, 6ft 6½in; usable floor area, 529 sq ft; entrance door dimensions, 56in × 30in; max seats, 101 at 34in pitch.

Fuel capacity: 7,813 Imp gal.

Performance: Opt-cost cruising speed, 452kt (520 m.p.h.) at 23,500ft and 135,000lb, with fuel consumption of 11,500lb/hr; balanced field length, max take-off weight, sea level, ISA, 6,600ft; sea level, ISA + 15°C, 7,450ft; at 5,000ft, ISA, 9,300ft landing field length, max landing weight, sea level, ISA, 6,600ft; range A (91-seat tourist), 2,910 n.m. (3,350 st.m.); range B (max fuel), 3,240 n.m. (3,730 st.m.) at 405kt (465 m.p.h.) with 17,131lb; cruise M.74; VNE, 335kt (409 m.p.h.) IAS; VNO, 320kt (368 m.p.h.) IAS; VSO, 95kt (109 m.p.h.) EAS at 115,000lb.

D.H.106 Comet 4C The Comet 4C is the intermediate-range version of the Comet family. It combines the 4B's longer fuselage with the Comet 4's wing and fuel tankage; this enables it to carry more payload than the Mk 4 at a slight sacrifice in maximum range. Three have been ordered by Mexicana, seven by United Arab Airlines, and four by MEA. RAF Transport Command is to have five.

Powerplant: Four Rolls-Royce Avon 524 RA.29/1 turbojets of 10,500lb static thrust each.

Dimensions: As Comet 4, except length, 118ft.

Weights: As Comet 4, except weight less fuel and payload (72-seat first-class), 77,500lb.

Payload accommodation: As Comet 4B.

Fuel capacity: As Comet 4.

Performance: Opt-cost cruising speed, 457kt (525 m.p.h.) at 33,000ft and 135,000lb with fuel consumption of 8,800lb/hr; balanced field length, max take-off weight, sea level, ISA, 6,350ft; sea level, ISA + 15°C, 7,100ft; 5,000ft, ISA, 8,750ft; landing field length, max landing weight, sea level, ISA, 6,570ft; range A (max payload), 3,075 n.m. (3,560 st.m.) (91-seat tourist); range B (max fuel), 3,745 n.m. (11,445lb); cruise M.74; VNE, 305kt (351 m.p.h.) IAS; VNO, 275kt (317 m.p.h.) IAS; VSO, 99kt (114 m.p.h.) IAS at 115,000lb.

D.H.114 Heron 1 and 2 Essentially a scaled-up, four-engined version of the Dove, the Heron was designed to bring "mainliner" standards to feeder-line routes. The Heron 1 prototype first flew on May 10, 1950. Initial production was of the Mk 1, which featured a fixed nosewheel undercarriage and non-feathering propellers. This version was superseded in production by the Heron 2, which has a retractable undercarriage and feathering propellers. About 150 Herons have been built, of which over 80 are in airline service. More are used by air forces, executive owners and by the Queen's Flight. Price new is about £60,000 less radio. Particulars below refer to the Heron 2.

Powerplant: Four D.H. Gipsy Queen 30 Mk 2s of 250 b.h.p. each driving de Havilland Hydromatic 2/1000/2 7ft propellers.

Dimensions: Span, 71ft 6in; length, 48ft 6in; height, 15ft 7in; wing area, 499 sq ft.

Weights: Max take-off, 13,500lb; landing, 13,150lb; zero fuel, 12,670 lb; capacity payload, 3,750lb; weight less fuel and payload, 8,996lb (including two crew).

Payload accommodation: Cabin volume, 515 cu ft; baggage and freight volume, 127 cu ft; cabin length, 23ft; max width, 4ft 6in; max height, 5ft 9in; usable floor area, 89 sq ft; dimensions of largest door, 51in × 33.5in; max seats, 17.

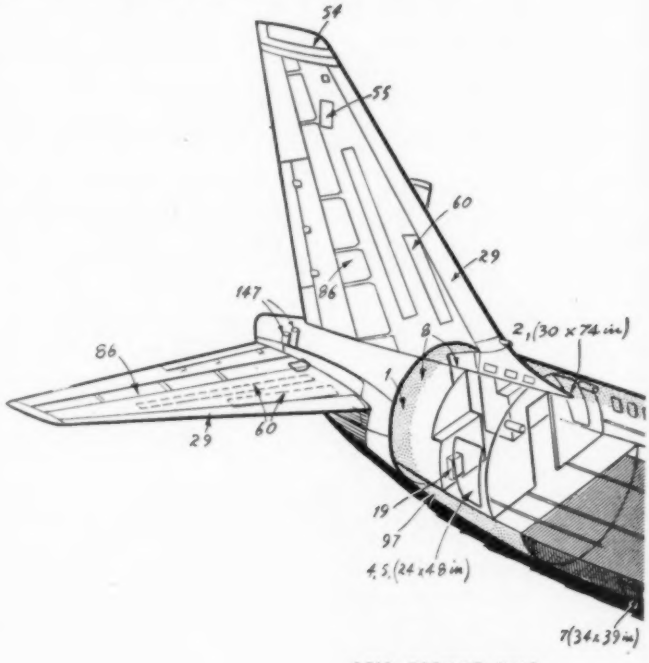
Fuel capacity: 412 Imp gal (495 US gal).

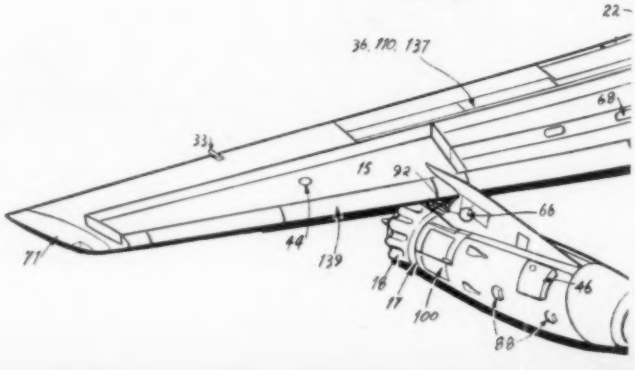
Performance: Cruising speed, 159kt (183 m.p.h.) at 8,000ft and 13,000lb; balanced field length, 3,570ft; range B, 1,538 n.m. (1,771 st.m.) at 158kt (183 m.p.h.) with 1,320lb payload.

D.H.121 Trident Mk 1 BEA issued a general specification for a "second-generation" jet airliner to the British aircraft industry in July 1956. Not until February 1958, after a long drawn-out political con-

DE HAVILLAND COMET 4B

"Flight" operators' reference drawing—see page 800 for key





First airliner to be powered by three rear-mounted turbojets, the D.H. Trident is due to make its first flight next month

troversy, were BEA allowed to place a provisional order for the D.H.121. Though de Havilland were prepared to finance the aircraft alone, in accordance with Government policy the Airco consortium was formed with Fairey and Hunting to design, manufacture and develop the D.H.121, which was named Trident in September 1960. This consortium was abandoned when de Havilland became merged into Hawker Siddeley Aviation during 1960, and Hunting and Fairey found themselves in another grouping, though these companies are still Trident subcontractors.

The original D.H.121 (*Flight*, July 25, 1958, p. 120) was an 111-seater (max) with a take-off weight of 123,000lb. Powerplant was three Rolls-Royce RB.141s of 12,000lb static thrust. During the early months of 1959, as RB.141 power increased, it became apparent that the 121 had grown too large for BEA's requirements. The design was revised around three Rolls-Royce RB.163s of 10,100lb static thrust each, with a max weight of 105,000lb (since increased) and seating reduced to a maximum of 100.

The engines are rear-mouted, and the unique triple-turbojet formula is claimed to satisfy most efficiently the thrust requirements of take-off and cruise ("with four engines the aircraft would be overpowered on take-off, and with two would be overpowered in the cruise"). The broad strategy of the 121 might be summed up as a 600 m.p.h. jet with a 6,000ft take-off and "optimized" economics for the shorter trunk-route stages of up to 1,700 miles.

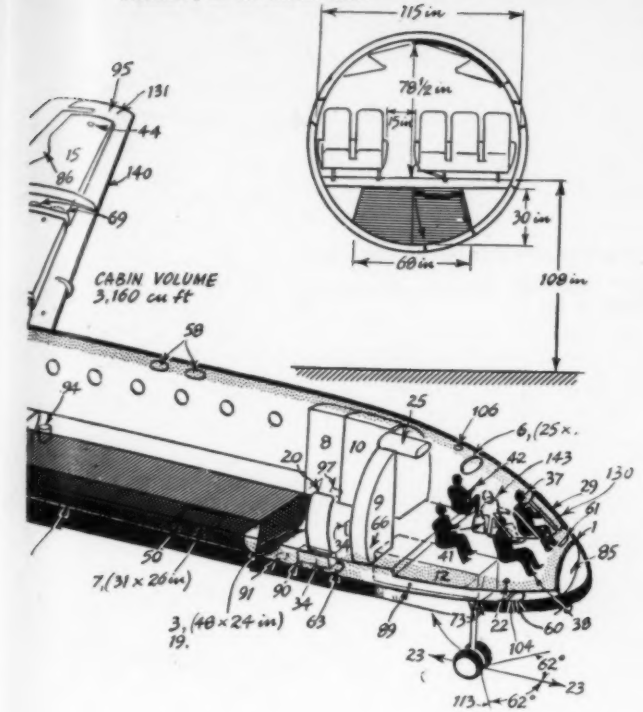
A firm contract for 24 aircraft, for delivery to BEA from mid-1963, was signed on August 12, 1959. All 24 aircraft should be delivered by September 1965. First flight of the 121 should take place in December 1961. Six more aircraft will join the flight test programme in 1962. From the outset the Trident, with its triplex control system (Smiths), is designed for autoflare, with full automatic landing envisaged before 1970. Value of the BEA contract is £28m with spares. A development of the Trident 1, the 1A, has improved payload-range performance.

Flight references: August 21, 1959, page 57; August 28, 1959, page 91; September 4, 1959, page 102; January 22, 1960, pages 102-104 and 120; February 19, 1960, pages 238-240 (blind landing).

Powerplant: Three Rolls-Royce RB.163 by-pass turbojets of 10,100lb static thrust each.

Dimensions: Span, 89ft 10in; length, 114ft 9in; height, 27ft; wing area, 1,358 sq ft; sweepback, 35°.

Weights: Max take-off 107,000lb, or 112,000lb with centre-section tankage; landing, 100,000lb; zero fuel, 85,500lb; capacity payload, 22,370lb; weight less fuel and payload, 63,130lb. [*Continued overleaf*



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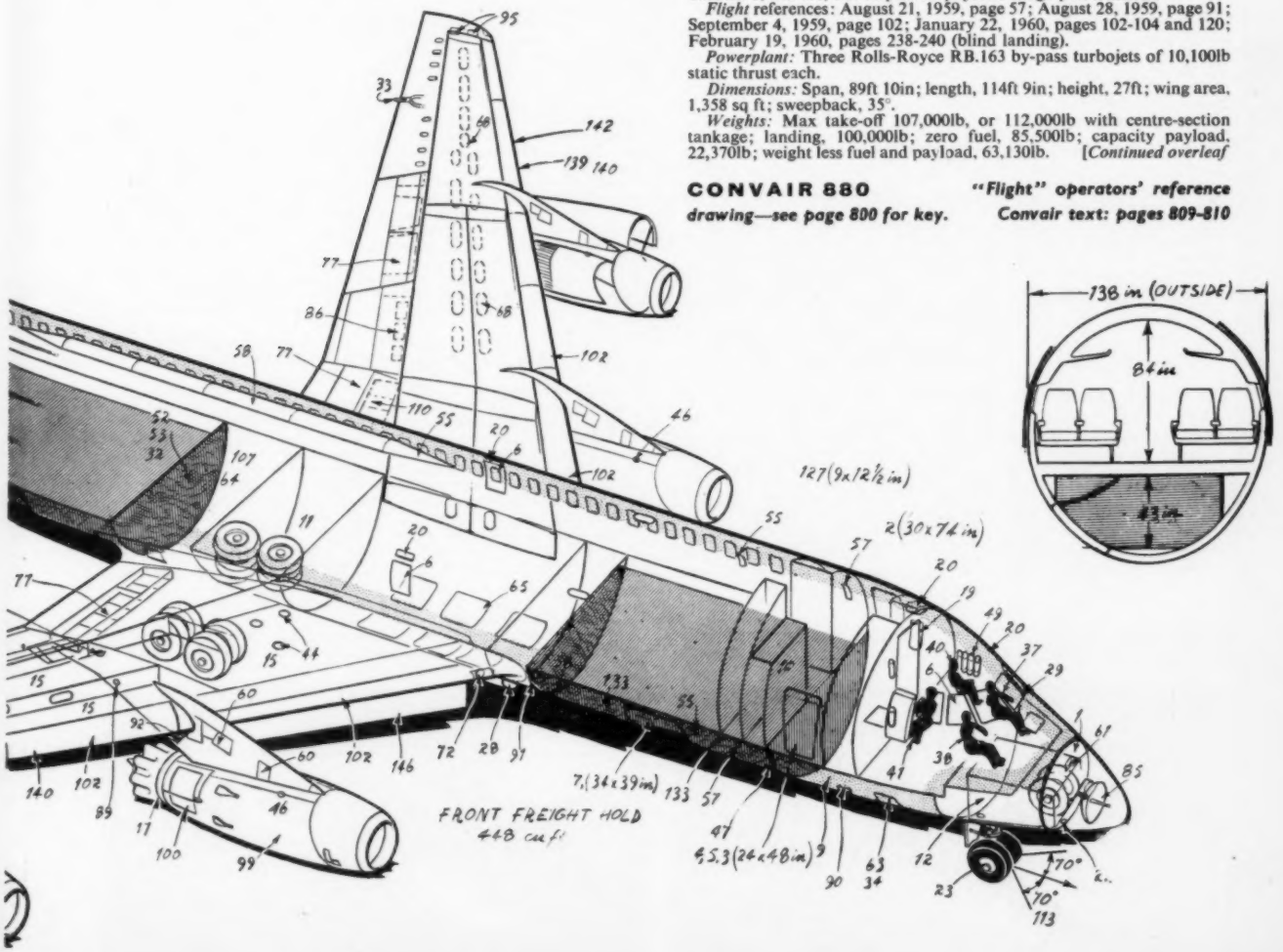
CONVAIR 880 *"Flight" operators' reference drawing—see page 800 for key.* *Convair text: pages 809-810*



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Payload accommodation: Cabin volume, 4,412 cu ft; baggage and freight volume, 620 cu ft; cabin length, 66ft 10½in (port side), 65ft 8in (starboard side); max width, 11ft 3½in; max height, 6ft 8in; max usable floor area, 708 sq ft; largest door, 62½in × 28in; max seats, 100 at 34in pitch.

Fuel capacity: 3,840 Imp gal, or 4,840 Imp gal with centre section tankage.

Performance: Opt-cost cruising speed at 32,000ft and 100,000lb, 508kt (585 m.p.h.); corres fuel consumption, 7,300lb/hr; range A (max payload), 1,460 n.m. (1,680 st.m.) or 2,420 n.m. (2,790 st.m.) with centre-section tankage; range B (max fuel), 3,050 n.m. (3,520 st.m.) with 9,325lb payload; cruise M.875; VNO 360kt (415 m.p.h.) EAS.

D.H.121 Trident Mk 2 First referred to by Sir Roy Dobson of Hawker Siddeley in March 1960, this is a project-study for a stretched development of the basic short-range Mk 1 intended for the medium-range market (2,000 miles-plus with max payload) at which the Boeing 727 is aimed.

D.H.125 Originally known as the Jet Dragon when it was announced in April 1961, though the name has in recent months been dropped, the D.H.125 is aimed specifically at the business and executive market. The first aircraft is scheduled to fly in June 1962. A contract for 60 Viper 520s has been signed by de Havilland with Bristol Siddeley to power the first 30 D.H.125s. The first aircraft has been ordered by Bristol Siddeley, first of all for engine development and later for executive use by the company. Deliveries of the D.H.125 are offered early in 1963. Basic price is £140,000; radar and radio would add about £25,000.

Powerplant: Two Bristol Siddeley Viper 520 of 3,000lb static thrust.

Dimensions: Span, 44ft; length, 47ft 6in; height empty, 14ft; wing area, 324 sq ft.

Weights: Max take-off, 18,500lb; max landing, 17,000lb.

Payload accommodation: Cabin accommodational length, 19ft 6in; max internal width, 5ft 10in; max height, 5ft 9in; dimensions of largest door, 51in × 36in; max number of seats, 8.

Performance: Opt-cost (i.e., typical cruising speed) at 36,000ft, 450 m.p.h.; take-off field length at sea level, 4,200ft; range A (max payload), more than 1,600 n.m.; cruise Mach number, 0.725.

D.H.126 This de Havilland project for a 30-seat jet for the DC-3 replacement market, powered by two turbofans, is understood to have been shelved for the time being.

Ambassador The Airspeed A.S.57 Ambassador first flew on July 10, 1947 and entered service in 1952 with BEA, who named it Elizabethan. Until 1957, BEA was the only operator, but in that year three were sold to Butler Air Transport of Australia. Only 21 of these high-wing monoplanes were built, and today BKS Air Transport operate four, Dan-Air three, Overseas Aviation four, Shell two, Rolls-Royce one (Tyne test bed). Four Elizabethans are at present in BEA storage awaiting sale at £69,500 each with zero-time engines and airframes.

Powerplant: Two Bristol Centaurus 661s of 2,625 b.h.p. driving D.H. Hydromatic four-blade 16ft propellers.

Data appeared in *Flight* of November 20, 1959, page 597.

DE HAVILLAND AIRCRAFT OF CANADA *Downsview, Toronto, Ontario, Canada. (Member of the Hawker Siddeley Group)*

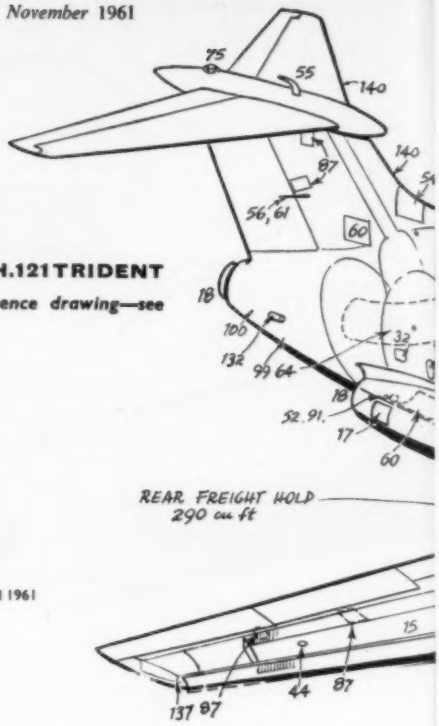
DHC.4 Caribou The Caribou had its origin in design studies for a "Twin Otter" weighing 13,000lb, with two Otter-type powerplants and a fixed undercarriage. The Caribou's ultimate configuration was determined by US and Canadian Army desires for rear loading, and the need for good STOL characteristics and climb after take-off, together with a reasonable single-engined ceiling. The first of three proptotypes made its maiden flight on July 30, 1958, and the first of large batches of AC-1A Caribous for the US Army was delivered on October 8, 1959. Production aircraft feature a 3ft 9in longer fuselage.

Powerplant: Two Pratt & Whitney R-2000-7M2 Twin Wasps of 1,450 b.h.p. each driving 13ft 1in Hamilton Standard propellers.

Data appeared in *Flight* for November 20, 1959, page 597.

DE HAVILLAND AIRCRAFT PTY *P.O. Box 30, Bankstown, NSW, Australia. (Member of the Hawker Siddeley Group)*

DHA.3 Drover First flown on January 23, 1948, the Drover was designed to Australian requirements as a post-war successor to the D.H.84 Dragon, with emphasis on simplicity (e.g., fixed undercarriage), ruggedness and a good performance with one engine inoperative. Only 20 Drovers were built, of which eight are in service with Fiji Airways, Qantas and TAA. The latter's Drovers are among six operated by the Royal Flying Doctor Service which have been re-engined with more powerful Lycoming O-360-A1A engines driving Hartzell propellers in place of the three Gipsy Major Mk 10s.



DE HAVILLAND D.H.121 TRIDENT

"Flight" operators' reference drawing—see page 800 for key

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DOUGLAS *The Douglas Aircraft Co, Santa Monica, California, USA.*

DC-3 The most famous and widely-used airliner ever built, the DC-3 occupies a unique position in air transport. It is a twin-engined unpressurized aeroplane capable of carrying 20-30 passengers on stages of up to about 1,000 miles at a cruising speed of about 170 m.p.h. It set entirely new standards in airliner design and operation which were universally accepted and copied.

The DC-3 is a development of the DC-1 and DC-2 (designed for TWA) which, with the Boeing 247 (designed for United), were the first airliners of the modern stressed-skin all-metal cantilever low-wing monoplane formula. It made its first flight on December 22, 1935, having itself originally been designed to meet an American Airlines requirement for a sleeper version of the DC-2 suitable for use on the longer trunk US domestic routes. However, it was the "Day Plane" model of the "Douglas Sleeper Transport" which became the DC-3. All told, a total of 10,928 DC-3s and military C-47s were built in the United States, in addition to about 2,000 under licence in Russia and 450 in Japan. Some 1,570 are still in service with 235 airlines—nearly as many as all other types of airliner taken together. The DC-3 in 1936 cost £18,000-£23,000 and resale prices today are around £25,000.

Powerplant: Two Pratt & Whitney R-1830-92s of 1,200 b.h.p. driving three-bladed Hamilton Standard Hydromatic 11ft 6in propellers.

Dimensions: Span, 95ft; length, 64ft ½in; height, 16ft 11½in; wing area, 987 sq ft.

Weights: Max take-off, 25,200lb (US passenger), 26,900lb (US freight), 28,000lb (UK); landing, 24,400lb (US passenger), 26,900lb (UK and US freight); no zero-fuel restriction; capacity payload, 5,380lb; weight less fuel and payload, 17,720lb.

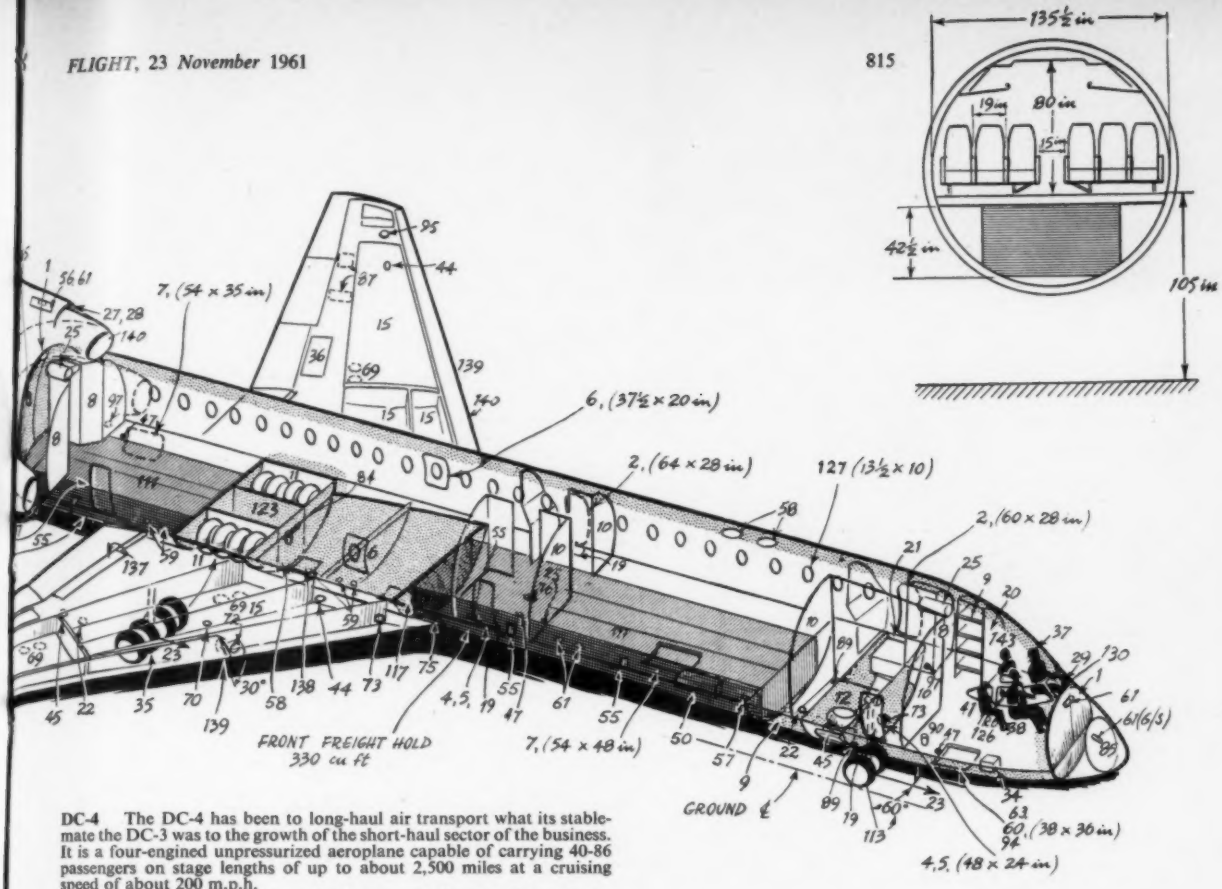
Payload accommodation: Cabin volume, 1,245 cu ft; baggage and freight volume, 160 cu ft; cabin length, 30ft ½in; max width, 7ft 8in; max height, 6ft 7in; max usable floor area, 191 sq ft; dimensions of largest door, 5ft 10in × 7ft (C-47); max seats, 28-36.

Fuel capacity: 670 Imp gal (805 US gal).

Performance: Cont cruising speed, 155kt (178 m.p.h.) at 10,000ft and 25,200lb; corres consumption 73.5 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 4,050ft; at SL, ISA + 15°C, 4,400ft; landing distance from 50ft, 1,980ft; range A (max payload), 173 n.m. (199 st.m.); range B (max fuel), 1,780 n.m. (2,505 st.m.); corres payload, 8,600lb; corres cruise speed, 155kt (178 m.p.h.).

Typifying fashion in executive jets, the D.H.125 is powered by two rear-mounted Bristol Siddeley Vipers

The DHC-4 Caribou combines STOL capabilities with a payload of 3½ tons of cargo or up to 30 passengers



DC-4 The DC-4 has been to long-haul air transport what its stablemate the DC-3 was to the growth of the short-haul sector of the business. It is a four-engined unpressurized aeroplane capable of carrying 40-86 passengers on stage lengths of up to about 2,500 miles at a cruising speed of about 200 m.p.h.

The origins of the DC-4 go back to a requirement for a larger medium-haul transport issued by the four largest American carriers (American, United, TWA and Pan American) in mid-1935. Douglas produced a prototype—the DC-4E—to meet this requirement; this first flew on June 7, 1938, but did not prove satisfactory and was rejected by the airlines. Douglas thereupon started an entirely new and rather smaller project which became the DC-4. This flew for the first time on February 14, 1942. Orders for 61 were placed by American, Eastern and United early in 1940 but deliveries were diverted to military purposes and the type went into large-scale production and use as a military transport until the end of the war. Some 1,163 military DC-4s were delivered as C-54s before production was switched to a civil model at the end of the war, and 79 of this version were built before manufacture of the DC-4 was stopped in favour of the DC-6. The DC-4 cost between £140,000 and £160,000 in 1946-47. A typical used price today is about £80,000. About 350 are in service with 110 airlines.

Powerplant: Four Pratt & Whitney R-2000-2SD-13Gs of 1,450 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 93ft 11in; height empty, 27ft 6¼in; wing area, 1,463 sq ft.

Weights: Max take-off, 73,000lb; landing, 63,500lb; zero fuel, 63,500lb; capacity payload, 12,700lb; weight less usable fuel and payload, 45,950lb.

Payload accommodation: Cabin volume, 3,775 cu ft; baggage and freight volume, 525 cu ft; cabin length, 63ft 8in; max width, 9ft 10½in; max height, 7ft ½in; max usable floor area, 470 sq ft; dimensions of largest door, 5ft 7in × 7ft 6in; max seats, 86.

Fuel capacity: 2,990 Imp gal.

Performance: Cont cruising speed, 177kt (204 m.p.h.) at 10,000ft and 64,600lb; corres consumption, 1,370lb/hr; balanced field length, max take-off weight, SL, ISA, 5,250ft; landing distance from 50ft, 2,760ft; range A (max payload), 1,860 n.m. (2,140 st.m.); range B (max fuel), 3,680 n.m. (4,230 st.m.); corres payload, 11,400lb; corres cruise speed, 175kt (201 m.p.h.).

DC-6 The DC-4 design achieved its full potential as a civil transport only after the end of the Second World War when it appeared in a more powerful stretched and pressurized form known as the DC-6. The DC-6 carries 70-90 passengers on stage lengths of more than 2,500 miles at cruising speeds of up to 280 m.p.h. It is thus considerably faster than its predecessor because of the higher installed power (9,600 h.p. for take-off instead of 5,800 h.p.) and because it can operate at greater heights with its pressurized passenger accommodation. Apart from the more powerful engines and the strengthened structure which they require and which permits higher operating weights, the DC-6 differs from the DC-4 in having double-slotted flaps of increased efficiency which hold down the approach speed of the original domestic model to little more than that of the DC-4, in spite of the much increased landing-weight.

The DC-6 resulted from discussions with United Air Lines about an aeroplane for the US transcontinental routes. This was in 1944 while the war was still in progress; three prototypes were ordered by the USAAF as the XC-112A. The first flight took place on February 15, 1946. After the war, manufacture for the airlines got under way and deliveries to United started in 1947. Some 175 DC-6s were built and 160 are still in service with 23 airlines. The DC-6 cost between £210,000 and £230,000 in 1946-47 and its price rose to about £310,000 in 1951. Resale price today is about £175,000.

Powerplant: Four Pratt & Whitney R-2800-CB-16 of 2,400 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 1in propellers.

Dimensions: Span, 117ft 6in; length, 100ft 7in; height empty, 28ft 5in; wing area, 1,463 sq ft.

Weights: Max take-off, 97,200lb; landing, 80,000lb; zero fuel, 74,000lb; capacity payload, 14,800lb; weight less usable fuel and payload, 57,200lb.

Payload accommodation: Cabin volume, 4,107 cu ft; baggage and freight volume, 374-518 cu ft; cabin length, 63ft 9in; max width, 9ft 10½in; max height, 7ft ½in; max usable floor area, 553 sq ft; dimensions of largest door, 3ft × 6ft; max seats, 86.

Fuel capacity: 3,550 Imp gal (4,260 US); water-methanol, 33 Imp gal.

Performance: Cont cruising speed 271kt (312 m.p.h.) at 19,600ft and 73,000lb; corres consumption, 350 Imp.gal/hr; balanced field length, max take-off weight, SL, ISA, 5,400ft; at 4,000ft ISA, 7,270ft at 84,000lb; landing distance from 50ft, 2,970ft; range A (max payload), 2,900 n.m. (3,330 st.m.); range B (max fuel), 3,400 n.m. (3,910 st.m.); corres payload 17,700lb; corres cruise speed, 244kt (280 m.p.h.).

DC-6A The success of the DC-6 suggested that further improvements in specific operating costs could be achieved with this same basic design by simply expanding its payload capacity. This was done with great success with the DC-6A, which appeared in 1949. Some were subsequently converted to passenger use and a mixed passenger/freighter version, the **DC-6C** was produced. Some 75 DC-6As and 6Cs were built for commercial operators of which 70 are still in service with 23 airlines. In addition, 167 military models of the DC-6A have been supplied to the US Services. The DC-6A cost between £460,000 and £480,000 in 1957-58. Used price today is holding up at more than £200,000.

Powerplant: Four Pratt & Whitney R-2800-CB-17 of 2,500 b.h.p. driving three-bladed Hamilton Standard Hydromatic 13ft 6in propellers.

Dimensions: Span, 117ft 6in; length, 105ft 7in; height empty, 28ft 8in; wing area, 1,463 sq ft.

Weights: Max take-off 107,000lb; landing, 88,200lb; zero fuel, 83,200lb; capacity payload, 28,188lb; weight less fuel and payload, 57,000lb.

Payload accommodation: Cabin volume, 4,360 cu ft; baggage and freight volume, 539 cu ft; cabin length, 68ft; max width, 9ft 10½in; max height, 7ft ½in; max usable floor area, 596 sq ft; dimensions of largest door, 6ft 6½in × 10ft 4in; max seats, 100.

Fuel capacity: 4,600 Imp gal (5,520 US gal); water-meth, 33 Imp gal.

Performance: Typical cruising speed, 274kt (315 m.p.h.) at 22,500ft and 88,200lb; corres consumption, 350 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,150ft; at 5,000ft, ISA, 5,420ft at 90,000lb; landing distance from 50ft, 3,100ft; range A (max payload), 2,540 n.m. (2,920 st.m.); range B (max fuel), 4,100 n.m. (4,720 st.m.); corres payload, 17,580lb; corres cruise speed, 230kt (265 m.p.h.).

Commercial Aircraft of the World . . .

TAI's three DC-8 Series 30s operate a round-the-world jet service in conjunction with Air France Boeing 707s

DC-6B The DC-6B passenger airliner was the logical outcome of the DC-6A freighter. It had a fuselage lengthened by another 13in and dispensed with the various special freighting provisions of its predecessor. It will accommodate between 60 and 100 passengers depending on the layout. The first DC-6B flew on February 2, 1951, and the type went into service with Western Air Lines in April of the same year. Flown by American Airlines on the prestige "coast-to-coast" routes, the DC-6B was for a time the fastest equipment in use. However, it was not so much for its performance, which does not differ greatly from that of the DC-6, as for its excellent economics that the DC-6B was to gain a great reputation, remain longer in production and be built in greater numbers than any other of the later developments of the DC-4. It is probable that lower seat-mile costs have, in fact, been achieved with DC-6Bs than with any other piston-engined equipment. A total of 287 DC-6Bs were produced and production was not completed until late in 1958, when manufacture of the DC-8 jet transport was getting under way; 264 are still in service with 40 airlines. The DC-6B cost about £500,000 in 1958 and resale price today is about £200,000-£250,000.

Powerplant: As DC-6A.

Dimensions: As DC-6A, except: length, 106ft 8in.

Weights: As DC-6A, except: capacity payload, 19,200lb; weight less fuel and payload, 64,000lb.

Payload accommodation: As DC-6A.

Fuel capacity: As DC-6A.

Performance: Typical cruising speed, 274kt (315 m.p.h.) at 22,500ft and 88,200lb; corres consumption, 350 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,150ft; at 5,000ft, ISA, 5,420ft at 90,000lb; landing distance from 50ft, 3,100ft; range A (max payload), 2,650 n.m. (3,050 st.m.); range B (max fuel), 4,100 n.m. (4,720 st.m.); corres payload, 14,000lb; corres cruise speed, 230kt (265 m.p.h.).

DC-7 This further development of the DC-4 family owed its origins to the competitive pressures on the domestic routes within the United States and particularly to the struggle between the airline "giants," American, United and TWA, on the transcontinental routes. In 1950 TWA ordered from Lockheed a stretched version of the Constellation, the L.1049C with the new powerful Wright Turbo-Compound engine. This aircraft was obviously going to outpace the DC-6B then in service and would, for the first time, offer non-stop coast-to-coast capability. American Airlines accordingly ordered from Douglas an equivalent development of the DC-6B using the same compound engine, and this became the DC-7. It entered service in 1953.

Although fast, the DC-7 is perhaps an example of a transport aeroplane which has been developed beyond the point of diminishing returns. Although the type served its purpose admirably—indeed, 107 were built—its economic characteristics are inferior to those of the DC-6B. The cost was about £570,000; price today is very much lower. About 95 are in service. *Flight* description: July 30, 1954.

Powerplant: Four Wright R-3350-988 TC-18 DA-4 Turbo-Compounds of 3,250 b.h.p. driving four-bladed Hamilton Standard Hydromatic 13ft 6in propellers.

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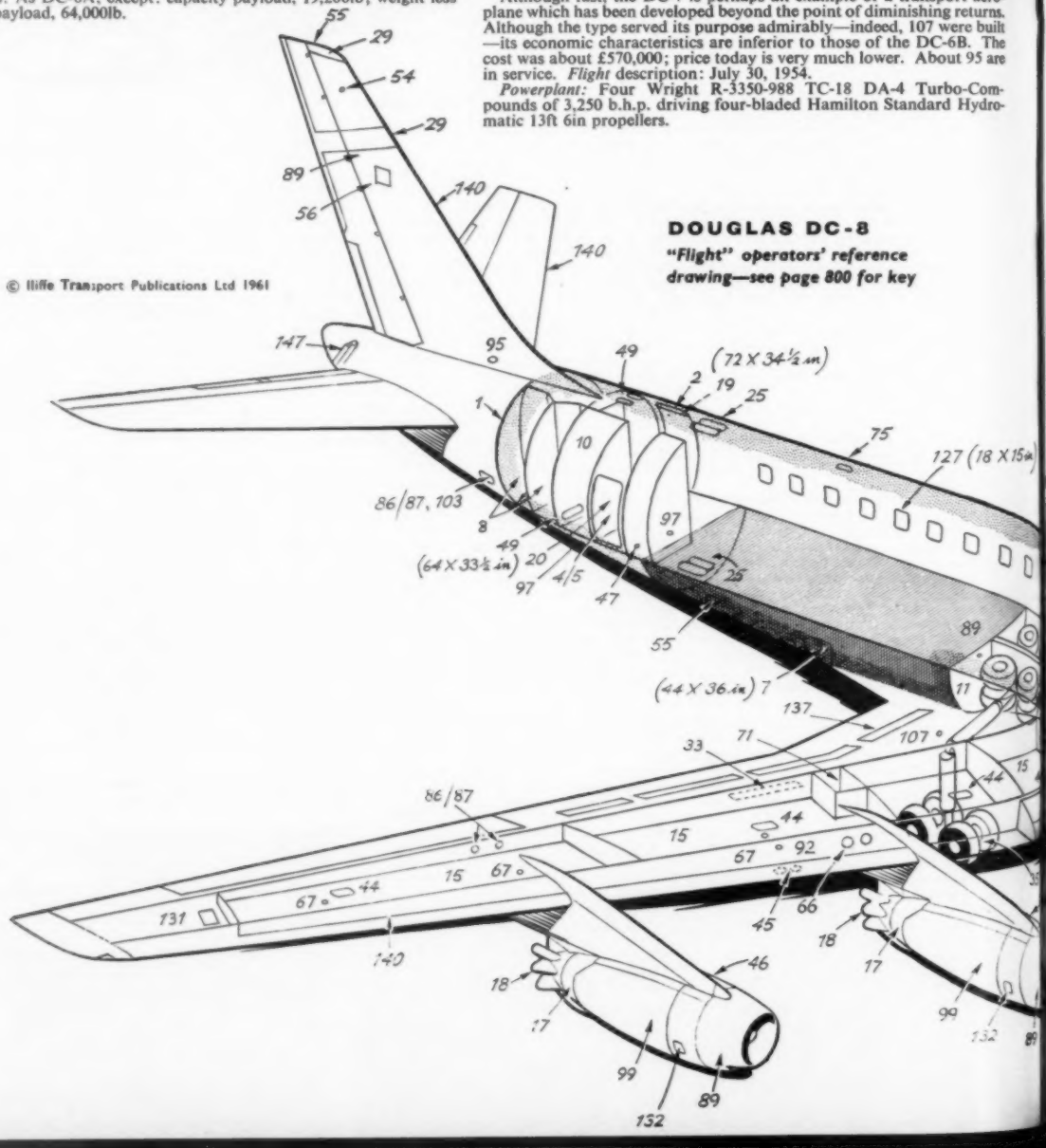
DOUGLAS DC-8

"Flight" operators' reference drawing—see page 800 for key

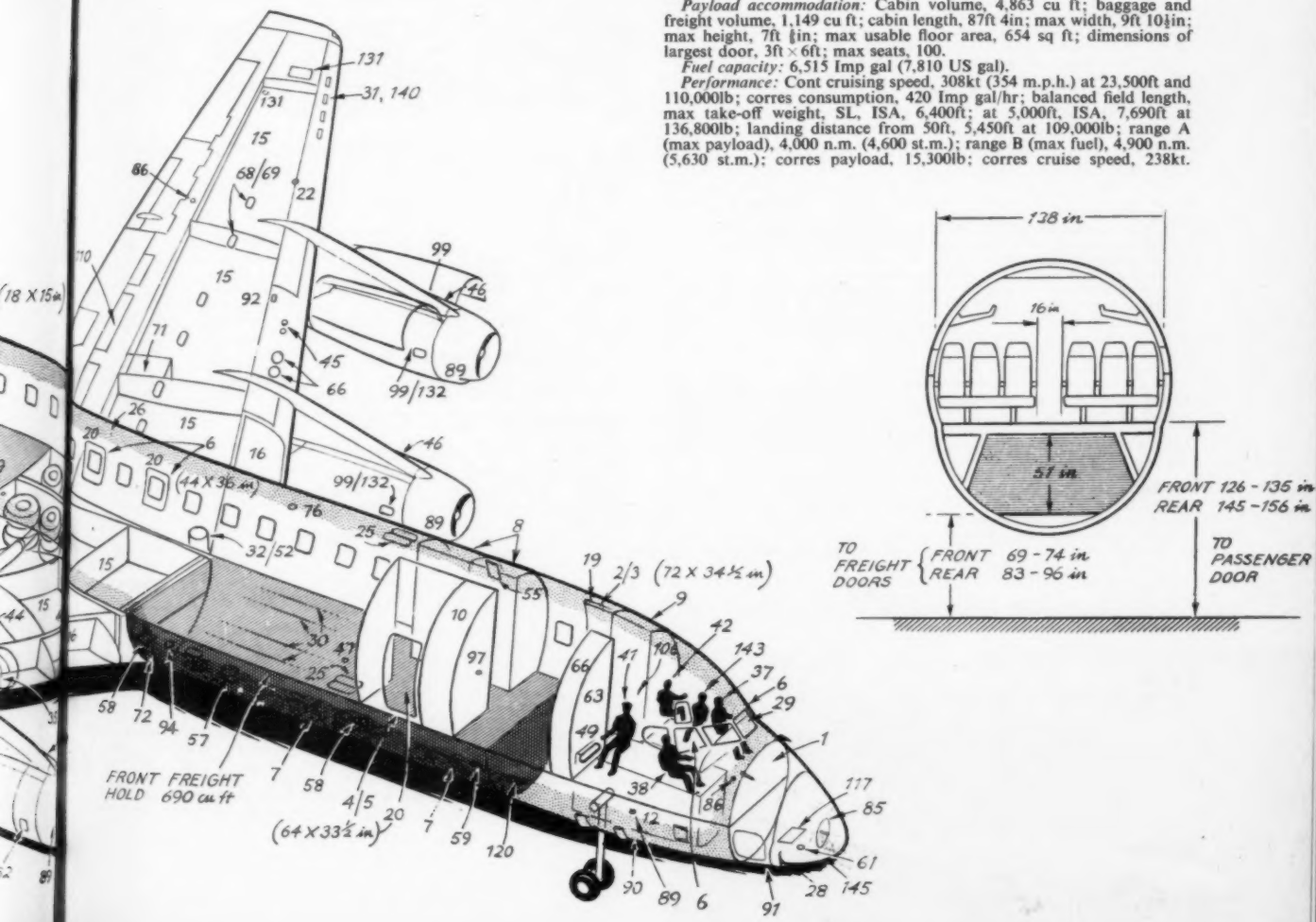


An increasing number of DC-7Cs superseded by the big jets are being converted to DC-7F freighters. The one shown here belongs to Japan Air Lines

Dimensions: Span, 117ft 6in; length, 108ft 11in; height empty, 28ft 7in; wing area, 1,463 sq ft.
Weights: Max take-off, 122,200lb; landing, 97,000lb; zero fuel, 91,000lb; capacity payload, 20,000lb.
Payload accommodation: Cabin volume, 4,647 cu ft; baggage and freight volume, 983 cu ft; cabin length, 84ft; max width, 9ft 10½in; max height, 7ft 1in; max usable floor area, 625 sq ft; dimensions of largest door, 3ft × 6ft; max seats, 100.
Fuel capacity: 4,600 Imp gal (5,520 US gal).
Performance: Typical cruising speed, 312kt (358 m.p.h.) at 24,200ft and 105,000lb; corres consumption, 420 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,060ft; at 5,000ft, ISA, 7,320ft at 118,800lb; landing distance from 50ft, 5,520ft at 95,000lb; range B (max fuel), 3,770 n.m. (4,430 st.m.).

DC-7B The DC-7B is similar to the DC-7 but is fitted with extra tankage for long-haul overwater operation and is cleared for higher weights. The DC-7B first flew on April 25, 1955, and entered service with Pan American less than a month later. A total of 110 DC-7Bs were built. The price of the DC-7B increased from about £680,000 in 1955 to about £820,000 in 1957. Resale price today is very low.
Powerplant: As DC-7.
Dimensions: As DC-7.
Weights: Max take-off, 126,000lb; landing, 102,000lb; zero fuel, 96,000lb; capacity payload, 21,516lb; weight less fuel and payload, 74,000lb.
Payload accommodation: As DC-7.
Fuel capacity: 5,380 Imp gal (6,460 US gal).
Performance: Cont cruising speed, 313kt (360 m.p.h.) at 24,300ft and 102,000lb; corres consumption, 420 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,350ft; at 5,000ft, ISA, 7,650ft at 122,600lb; landing distance from 50ft, 5,950ft; range A (max payload), 2,850 n.m. (3,280 st.m.); range B (max fuel), 4,275 n.m. (4,910 st.m.); corres payload, 11,600lb; corres cruise speed, 248kt (285 m.p.h.).

DC-7C The DC-7 and DC-7B were criticized in service for their relatively high interior noise and vibration levels, which resulted from the 3,250 b.h.p. Wright compound engines in an airframe designed originally (as the DC-4) for units of 1,450 h.p. This led Pan American to discuss with Douglas ways of improving the design while stretching it still further to provide non-stop North Atlantic range. Ability to fly the North Atlantic routes non-stop on a high percentage of occasions in the critical westbound direction against the strong prevailing winds had long been a major objective of all the competing Atlantic carriers, so that the DC-7C marked an important step forward both operationally and commercially. Douglas developed the DC-7C from the DC-7B in the short space of about a year, extending the wing by the insertion of an additional 10ft of centre section. Altogether 121 DC-7Cs were sold. This was the last stretch of the famous DC-4/7 series. The DC-7C finally went out of production late in 1958 at the same time as the DC-6B; 117 are still in service with 12 airlines. The DC-7C cost about £800,000 in 1956 and increased to about £930,000 by 1958. Resale price today is very much lower. *Flight* description: July 6, 1956, page 51.
Powerplant: Four Wright R-3350-988 TC-18 EA-4 Turbo-Compounds of 3,400 b.h.p. driving four-bladed Hamilton Standard 14ft propellers.
Dimensions: Span, 127ft 6in; length, 112ft 3in; height empty, 31ft 10in; wing area, 1,637 sq ft.
Weights: Max take-off, 143,000lb; landing, 111,000lb; zero fuel, 101,500lb; capacity payload, 23,350lb; weight less fuel and payload, 82,000lb.
Payload accommodation: Cabin volume, 4,863 cu ft; baggage and freight volume, 1,149 cu ft; cabin length, 87ft 4in; max width, 9ft 10½in; max height, 7ft 1in; max usable floor area, 654 sq ft; dimensions of largest door, 3ft × 6ft; max seats, 100.
Fuel capacity: 6,515 Imp gal (7,810 US gal).
Performance: Cont cruising speed, 308kt (354 m.p.h.) at 23,500ft and 110,000lb; corres consumption, 420 Imp gal/hr; balanced field length, max take-off weight, SL, ISA, 6,400ft; at 5,000ft, ISA, 7,690ft at 136,800lb; landing distance from 50ft, 5,450ft at 109,000lb; range A (max payload), 4,000 n.m. (4,600 st.m.); range B (max fuel), 4,900 n.m. (5,630 st.m.); corres payload, 15,300lb; corres cruise speed, 238kt.



Commercial Aircraft of the World . . .

DC-7F Douglas have been converting to special order on a production line at Santa Monica 33 DC-7 series aircraft for all-cargo use, designation becoming DC-7F ("Speedfreighter") after fitting enlarged fore and aft cargo doors, heavier floor and floor beam structure, lining inside fuselage walls with glass-fibre laminate, and removing all windows. Cost of conversion averages about £115,000 per aircraft. The first DC-7F went into service with American Airlines in September 1959.

Conversion orders have been placed by American Airlines, 15 DC-7B; United, six DC-7B; Panagra, one DC-7B; KLM, two DC-7C; Alitalia, two DC-7C; BOAC, two DC-7C; JAL, two DC-7C; and Riddle, three DC-7C (plus seven more on option).

A special version with pallets-and-rollers cargo loading is available.

Typical data for a DC-7B conversion are as follows:—

Weights: Max take-off, 126,000lb; max landing, 106,800lb; max zero fuel, 100,800lb; capacity payload, 34,000lb (38,000lb for the DC-7C conversion).

Payload accommodation: Max internal width, 9ft 10½in; volume, 5,000-plus cu ft; dimensions of largest door, 6ft 6in × 10ft 4in.

DC-8 Latest addition to the world's most respected family of airliners was announced in 1955, first flown May 30, 1958, certificated (JT3 domestic model) on August 31, 1959, and introduced into service simultaneously by United Air Lines and Delta on September 18, 1959. A total of 172 have been ordered by 20 airlines.

Like its rival the Boeing 707, the DC-8 is offered in a variety of versions. There are two domestic (series 10 and 20) and three international models (series 30, 40, 50) with different tankages and engines. All versions of the DC-8 are dimensionally identical, except for wing area. To improve range, speed and payload, Douglas has designed an extended leading edge for the full span of the wing. The new leading edge extends the chord 4 per cent and wing area has gone up to 2,883 sq ft. The extended leading edge is also available as a "retrofit" on delivered aeroplanes, and has been incorporated on intercontinental and some domestic DC-8s from No. 151. The extended leading edge has improved specific range by 8 per cent, Mach number by 0.02, and has reduced cost per ton-mile by more than 1 per cent.

The domestic DC-8s are powered either by Pratt & Whitney JT3C or JT4A engines; the international versions have JT4A or Rolls-Royce Conways. The order book is as follows: **Aeronaves de Mexico,** one-30, one-50 (from October 1960); **Alitalia,** ten -40 (from April 1960); **CPAL,** four -40 (from February 1961); **Delta,** six -10, three -50 (from July 1959); **Eastern,** fifteen -20 (from January 1960); **Iberia,** three -50 (from May 1961); **JAL,** five -30, one -50 (from July 1960); **KLM,** seven -30, six -50 (from March 1960); **National,** three -20, seven -50 (from February 1960); **Northwest,** five -30 (from May 1960); **Pan American,** nineteen -30 (from February 1960); **Panagra,** four -30 (from April 1960); **Panair do Brasil,** two -30 (from March 1961); **Philippine,** two -30; **SAS,** seven -30 (from March 1960); **Swissair,** three -30 (from April 1960); **TCA,** eleven -40 (from February 1960); **TAI,** three -30 (from July 1960); **Trans Caribbean,** one -30 (from November 1961); **United,** twenty-three -10, fourteen -20, three -50 (from May 1959); **UAT,** two -30 (from June 1960).

DC-8-10

Powerplant: Four Pratt & Whitney JT3C-6 turbojets of 13,500lb static thrust each.

Dimensions: Span, 142ft 5in; length, 150ft 6in; height empty, 42ft 4in; wing area, 2,725 sq ft; (2,883.6 sq ft with glove); sweepback at quarter chord, 30°.

Weights: Max take-off, 273,000lb; max landing, 193,000lb; zero fuel, 165,900lb; capacity payload (weight limited), 37,315lb; manufacturer's weight, empty, 119,797lb.

Payload accommodation: Cabin volume (less flight deck), 7,617 cu ft; baggage and freight volume, 1,390 cu ft; cabin accommodational length, 103ft 8in; max internal width, 11ft 7in; max height, 8ft; max usable floor area (less flight deck), 1,078.5 sq ft; dimensions of largest door, 34½in × 72in; max number of seats, 120-177 at 32-35in pitch.

Fuel capacity: 17,550 US gal.

Water-methanol capacity: 720 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 220,000lb, 472kt; take-off field length, 9,550ft; landing field length, 6,410ft; range A (max payload), 3,760 n.m.; range B (max fuel), 4,067 n.m.; corres payload, 27,840lb; cruise Mach number, 0.82; VNE, 390kt IAS; VNO (variable with altitude), 340-376kt IAS; VSO, 133kt IAS, VSF = 103kt IAS.

DC-8-20

Powerplant: Four Pratt & Whitney JT4A-3 (or -5, -9, -10) of 15,800lb-16,800lb static thrust each.

Dimensions: As DC-8-10.

Weights: Max take-off, 276,000lb; max landing, 193,000lb; zero fuel, 167,500lb; capacity payload, 35,443lb; manufacturer's weight, empty, 123,876lb.

Payload accommodation: As DC-8-10.

Fuel capacity: As DC-8-10.

Water-methanol capacity: As DC-8-10.

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 220,000lb, 472kt; take-off field length, 7,100ft; landing field length, 6,410ft; range A (max payload), 4,050 n.m.; range B (max fuel), 4,425 n.m.; corres payload, 26,600lb; cruise Mach number, 0.82; VNE, 390kt IAS; VNO, 340-376kt IAS; VSO, 133kt IAS; VSF = 103kt IAS.

DC-8-30

Powerplant: Four Pratt & Whitney JT4A-3 (or -5, -9, -10, -11, -12) of 15,800lb-17,500lb static thrust each.

Dimensions: As DC-8-10.

Weights: Max take-off, 315,000lb; max landing, 207,000lb; zero fuel, 178,200lb; manufacturer's weight, empty, 126,330 lb.

Payload accommodation: As DC-8-10.

Fuel capacity: 23,392 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 230,000lb, 464kt; take-off field length, 9,620ft; landing field length, 6,800ft; range A (max payload), 4,005 n.m.; range B (max fuel), 5,250 n.m.; corres payload, 25,475lb; cruise Mach number, 0.82; VNE, 390kt IAS; 340-374kt IAS; VSO, 136kt IAS; VSF = 107kt IAS.

DC-8-40

Powerplant: Four Rolls-Royce Conway RCo.12s of 18,000lb static thrust each.

Dimensions: As DC-8-10.

Weights: As DC-8-30, except zero fuel, 177,100lb; manufacturer's weight, empty, 124,790lb.

Payload accommodation: As DC-8-10.

Fuel capacity: As DC-8-30.

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 230,000lb, 464kt; take-off field length, 9,050ft; landing field length, 6,800ft; range A (max payload), 5,310 n.m.; range B (max fuel), 5,905 n.m.; corres payload, 23,375lb; cruise Mach number, 0.82; VNE, 390kt IAS; VNO, 340-374kt IAS; VSO, 136kt IAS; VSF = 107kt IAS.

DC-8-50

Powerplant: Four Pratt & Whitney JT3D-3 turbofans of 18,000lb static thrust each.

Dimensions: As DC-8-10.

Weights: As DC-8-40 except zero fuel, 176,500lb; capacity payload, 41,645lb; manufacturer's weight, empty, 124,800lb.

Payload accommodation: As DC-8-10.

Fuel capacity: As DC-8-30.

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 220,000lb, 473kt; corres s.f.c., 0.0420 n.m./lb; take-off field length, 25° flap, max take-off weight, SL, 9,300ft; landing field length, max landing weight, SL, 6,555ft; range A (max payload), 5,855 n.m.; range B (max fuel), 6,550 n.m.; corres payload, 25,915lb; cruise Mach number, 0.82; VNE, 390kt IAS; VNO, 340-374kt IAS; VSO, 136kt IAS; VSF = 107kt IAS.

DC-8F Announced in April 1961, the Jet Trader version of the DC-8 is designed for all-freight or mixed cargo-passenger work. Original schedule called for first flight in August 1962 and deliveries at the end of 1962. It has the same powerplant as the DC-8-50 (JT3D-3 turbofans), and incorporates the wing leading-edge modifications. Interior arrangements are variable, ranging from the all-cargo aircraft, capable of carrying up to 94,668lb of bulk-loaded freight or 91,113lb on pallets, to an all-passenger transport capable of seating 183 economy-class passengers. A typical mixed configuration quoted by Douglas is 54 passengers with baggage, 54,500lb of cargo and fuel reserves to give an operating range of 4,000 miles. The forward cargo door measurs 85in × 140in. Maximum flexibility is provided for by a removable bulkhead, replacing the fixed bulkhead midway between the cargo and passenger sections in the original model. This enables passenger loads of 24, 54, 84 or 114 to be carried with a proportionate reduction in cargo space. With the bulkhead at the midway point, the DC-8F will carry 84 passengers and six 81in × 110in pallets, and a payload amounting to 87,440lb. Payload increases as the passenger volume is decreased because of the greater density of freight.

Powerplant: Four Pratt & Whitney JT3D turbofans of 18,000lb static thrust each.

Dimensions: As DC-8-10 except wing area, 2,883.6 sq ft.

Weights: Max take-off, 315,000lb; max landing, 240,000lb; zero fuel, 224,000lb; capacity payload, 88,022lb; manufacturer's weight, empty, 130,207lb.

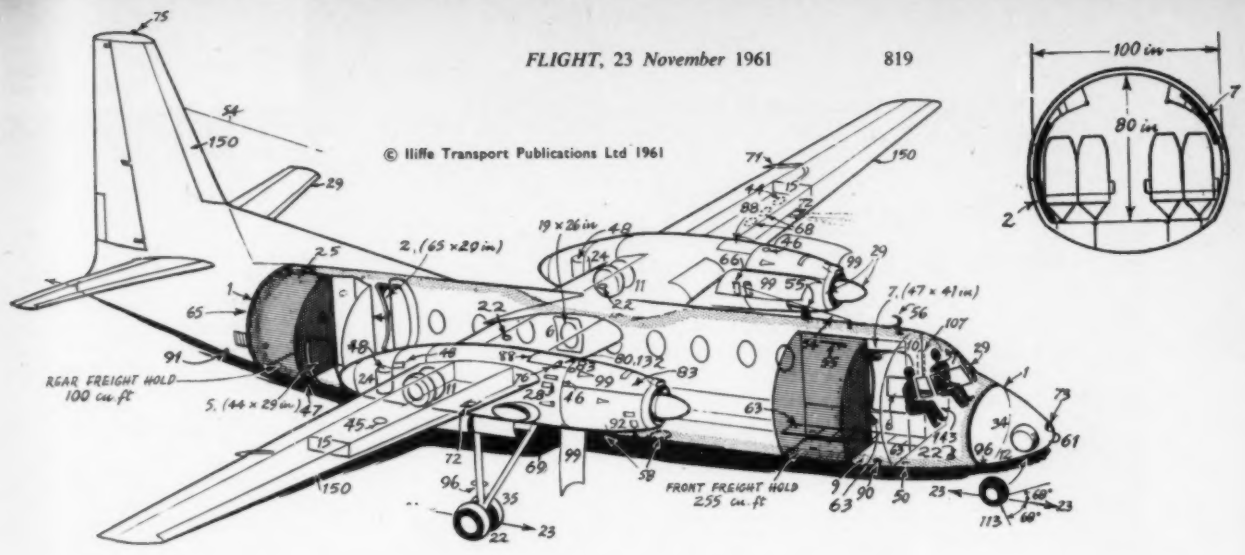
Payload accommodation: Cabin volume (less flight deck), 7,920 cu ft; baggage and freight volume, 1,390 cu ft; cabin accommodational length, 108ft 5in; max internal width, 11ft 7in; max height, 8ft; max usable floor area (less flight deck), 1,110 sq ft; dimensions of largest door, 85in × 140in; max number of seats, 219 at 28in pitch.

Fuel capacity: As DC-8-30.

Performance: Opt-cost (i.e., typical) cruising speed at 35,000ft and 220,000lb, 473kt; corres s.f.c., 0.0420 n.m./lb; take-off field length, 25° flap, max take-off weight, SL, 9,300ft; landing field length, max landing weight, SL, 7,450ft; range B (max fuel), 6,550 n.m.; corres payload, 28,830lb; cruise Mach number, 0.82; VNE, 390kt IAS; VNO, 340-374kt IAS; VSO, 147kt IAS; VSF = 115kt IAS.

Douglas Model 2086 This is a project for a short-haul jet airliner. Powerplant would be two JTF10A-2 turbofans of 10,000lb static thrust. Unofficial data are as follows: span, 84ft 8in; length, 95ft 2in; sweepback, 24°; seating, 56-77; gross weight, 69,000lb; cruising speed, 515 m.p.h. at 25,000ft; field length required (90°F, 56 passengers for 300 miles), 5,000ft.

The executive Grumman Gulfstream also has possibilities as a DC-3 replacement for airline use



FOKKER FRIENDSHIP *"Flight" operators' reference drawing—see page 800 for key*

GRUMMAN *Grumman Aircraft Engineering Corp, Bethpage, Long Island, New York, USA.*

Grumman Amphibians The Grumman G-21 **Goose** six-seater airline and executive amphibian first flew in June 1937, powered by two 450 h.p. Pratt & Whitney R-985 Wasp Juniors, and a total of 345 were built. There are 30 still in service with 12 operators, mostly in Alaska, Canada and the Caribbean. The Goose was followed by the smaller, five-seater G-44 **Widgeon,** first flown in July 1940, and powered by two 200 h.p. Ranger 6-440-C5 engines. About half a dozen of the 286 Widgeons built remain in airline service. The G-73 **Mallard,** first flown in 1946, is rather larger; it seats up to ten and is powered by two 600 h.h.p. Pratt & Whitney R-1340-S3H-1 Wasps. Only two of the 61 Mallards built are in airline service, with Pacific Western Airlines. The SA-16A-GR **Albatross** is much larger, having over twice the gross weight and engine power and a 13ft 4in greater wing span. Albatross production (over 300 have been built) has been entirely for military use, but three ex-USAF SA-16As are used by Transocean Airlines. Also in military use is the SA-16B, a variant with a larger wing span. *Flight* reference to the G-21 Goose: November 20, 1959.

G-159 Gulfstream The twin-Dart Gulfstream is Grumman's contender for the American "heavy twin" executive market. The prototype made its first flight on August 14, 1958, and the company has now received orders for some 56 aircraft. Up to 12 passengers can be accommodated, or 19 in a high-density layout. Current basic price is about $1m.

Flight reference: April 3, 1959.

Powerplant: Two Rolls-Royce RDa.7/2 Dart 529 turboprops of 2,190 e.h.p. each driving 11ft 6in diameter Rotol four-bladed propellers.

Dimensions: Span, 78ft 4in; length, 63ft 8in; height, 22ft 9in; wing area, 615 sq ft.

Weights: Max take-off, 35,100lb; landing, 33,600lb; zero fuel, 26,170lb; capacity payload, 4,270lb; weight less fuel and payload, 21,909lb.

Payload accommodation: Cabin volume, 1,040 cu ft; baggage and freight volume, 100 cu ft; cabin length, 33ft; max width, 7ft 4in; max height 6ft 1in; usable floor area, 177 sq ft; dimensions of largest door, 63in × 36in; max seats, 19 at 35in pitch.

Fuel capacity: 1,291 Imp gal (1,550 US gal), and 600lb water-methanol.

Performance: Cont cruising speed, 302kt (348 m.p.h.) at 25,000ft and 27,500lb, with a fuel consumption of 1,400lb/hr, balanced field length, max take-off weight, sea level, ISA, 4,480ft; sea level, ISA + 15°C, 4,810ft; at 5,000ft, ISA, 5,700ft; landing distance from 50ft, 2,680ft; range A (max payload), 1,059 n.m. (1,218 st.m.); range B (max fuel), 2,448 n.m. (2,818 st.m.); corres payload, 2,740lb; V_{NE}, 310kt (357 m.p.h.) ISA; V_{NO}, 290kt (334 m.p.h.) IAS; V_{SO}, 75½kt (87 m.p.h.) EAS.

FAIRCHILD *Fairchild Aircraft and Missiles Division, Fairchild Engine and Airplane Corporation, Hagerstown, Maryland, USA.*

F-27 Construction of the F-27 by Fairchild in America followed from a long-standing association with Fokker. An agreement was concluded in April 1956 and work began two months later. The first Hagerstown-built aircraft flew on April 12, 1958.

Three versions are offered by the US manufacturer: a local-service airliner with up to 44 seats, an executive aircraft (the **F-27F**) now with an increased take-off-weight of 39,400lb and landing weight of 37,500lb, and a cargo aircraft (the **F-27B**) with a strengthened floor and larger forward door. Most of Fairchild's 13 airline customers have specified higher-powered Darts, and the F-27F is powered by Dart RDa.7 Mk 528-7Es. Airline versions powered by Dart 528s are referred to as **F-27As.** Another variant is the **F-27G,** which will have a maximum range greater than the F-27F, and a take-off-weight of 42,000lb. Certification should be early next year.

The first delivery was made to West Coast Airlines on June 22, 1958, and this airline inaugurated the world's first Friendship services on September 28, 1958. Order book: see *Flight* September 7, 1961. Some 86 F-27s have now been sold. The following figures refer to the F-27A.

Powerplant: Two Rolls-Royce Dart RDa.7 528-7Es of 2,105 e.h.p.

Dimensions: As Fokker F.27 except length, 77ft 2in with radar.

Weight: Max take-off, 42,000lb; max landing, 37,500lb; zero fuel, 35,700lb; capacity payload, 10,194lb; weight less fuel and payload, 23,807lb.

Payload accommodation: Cabin volume (less flight deck), 2,118 cu ft; baggage and freight volume, 180 cu ft; cabin length (total) 47ft 4in; max usable floor area (less flight deck) 225.5 sq ft; max seats, 44. Remainder as Fokker F.27.

Fuel capacity: As Fokker F.27.

Performance: Typical cruising speed, 260kt (300 m.p.h.) at 20,000ft and 38,000lb; take-off field length, SL, ISA, 4,370ft; ISA + 15°C, 4,680ft; ISA, 5,000ft, 5,610ft; landing distance, SL, ISA, 2,680ft; range A (max payload) 960 n.m. (1,100 st.m.); range B (max fuel), 1,100 n.m. (1,270 st.m.) corres payload, 9,150lb; corres cruise speed, 262kt.

FOKKER *Royal Netherlands Aircraft Factories Fokker, Schiphol-Zuid, Amsterdam, Holland.*

F.27 Friendship Development of Fokker's widely-selling turboprop DC-3 replacement has continued this year, with increases in maximum take-off weight approved in the summer, and certification pending for an increase in the cabin pressure differential. This will permit a cruising altitude of 25,000ft at a cabin altitude of 8,000ft. There are now seven production Friendship versions, in all of which either Rolls-Royce Dart RDa.6 or RDa.7s, of 1,600 and 1,910 s.h.p. respectively, can be installed. There is the standard 36 to 48 seat **F.27 Mk 100** and **Mk 200** Friendship airliner (available with two cabin lengths); the 52-seat high-density Friendship; the Friendship de Luxe executive transport; the Friendship All-Company transport which embodies both executive and staff accommodation; the Freightship all-cargo aircraft; the **Mk 300** and **Mk 400** Friendship Combiplane variable passenger-cargo aircraft and the F.27M Troopship military transport. Designed and ready to be built against orders is the F.27 "Long Friendship," with RDa.7s and a fuselage stretched by 4ft 11in to seat 44 passengers in its standard form, but with increased freight accommodation and the enlarged forward freight-loading door a standard, rather than optional, feature.

Fokker have now sold 120 Friendships, 34 of them ordered in 1961. These figures do not include licence-built Fairchild F-27s. Airline customers are: Aer Lingus, 7 (RDa.6); ALA-Austral, 4 (RDa.6); All-Nippon, 10 (RDa.7); Ansett-ANA and subsidiaries, 9 (RDa.7); Braathen's SAFE, 4 (RDa.6); DETA, 3 (RDa.7); DTA, 2 (RDa.7); EAA, 3 (RDa.7); East-West, 1 (RDa.6); IAC, 10 (RDa.6); KLM, 2 (RDa.6, Combiplanes); Luft-transport Unternehmen, 1 (RDa.6, Combiplane); Luxair, 1 (RDa.6); Mac.Robertson Miller, 1 (RDa.7); NZNAC, 8 (RDa.6); Nigeria Airways, 5 (RDa.7); PIA, 5 (RDa.7, one a Combiplane); PAL, 5 (RDa.6); Sudan Airways, 3 (RDa.7); TAA, 10 (RDa.6 and RDa.7) and THY, 5 (RDa.6).

Mac.Robertson Miller's Fokker Friendship operates up the west coast of Australia from Perth to Darwin

Commercial Aircraft of the World . . .

Maritime Central Airways and Nordair are the first export customers for the Herald

Fokker F.27 Mark 100

Powerplant: Two Rolls-Royce Dart RDa.6 Mk 511-7E turboprops of 1,600 s.h.p. driving Rotol 12ft diameter 4-bladed propellers.

Dimensions: Span, 95ft 2in; length 77ft 1in; height empty, 27ft 11in; wing area, 754 sq ft.

Weights: Max take-off, 39,000lb; max landing, 37,500lb; zero fuel, 35,200lb; capacity payload, 12,278lb; weight less fuel, crew and payload, 22,180lb.

Payload accommodation: Cabin volume (less flight deck), 2,136 cu ft; baggage and freight volume, 225 cu ft; cabin accommodational length, 30ft 10in; max internal width, 8ft 4in; max height, 6ft 7.5 in; max usable floor area (less flight deck), 312 sq ft; dimensions of larger door, 47 × 41in; seats provided, 40 at 35½in pitch.

Fuel capacity: 1,130 Imp gal (1,357 US gal).

Water-methanol capacity: 66 Imp gal (79 US gal).

Performance: Optimum-cost cruise at 17,000ft and 35,000lb, 236kt (272 m.p.h.); corres specific fuel consumption, 0.172 n.m./lb; take-off field length at 39,500lb, 4,950ft; landing field length, at 37,500lb, 3,160ft; range A (max payload), 600 n.m.; range B (max fuel), 1,550 n.m.; corres payload, 6,900lb.

Fokker F.27 Mark 200

Powerplant: Two Rolls-Royce Dart RDa.7 Mk 528-7E of 1,910 s.h.p. driving Rotol 11ft 6in diameter 4-bladed propellers.

Dimensions: As Mk 100.

Weights: Max take-off, 42,000lb; max landing, 37,500lb; zero fuel, 35,700lb; capacity payload, 12,290lb; weight less fuel, crew and payload, 22,660lb.

Payload accommodation: As Mk 100.

Fuel capacity: As Mk 100.

Performance: Optimum-cost cruising speed at 20,000ft, and 35,000lb, 264kt; corres specific fuel consumption, 0.1805 n.m./lb; take-off field length at max take-off weight, 3,450ft; landing field length at 37,500lb, 3,160ft; range A (max payload), 1,030 n.m.; range B (max fuel), 1,520 n.m.; corres payload, 9,400lb.

F.27 Mark 300 Freightship/Combiplane

Powerplant: As Mk 100.

Dimensions: As Mk 100.

Weight: As Mk 100 except capacity payload, 12,950lb; weight less fuel, crew and payload, 21,750lb.

Payload accommodation: Baggage and freight volume, 1,977 cu ft; cabin accommodational length, 47ft 6in; dimensions of larger door, 91.5 × 70in. All-cargo.

Fuel capacity: As Mk 100.

Performance: Optimum-cost cruise at 17,000ft and 35,000lb, 236kt; corres specific fuel consumption, 0.172 n.m./lb; take-off field length at 37,000lb, 4,950ft; landing field length, at 37,500lb, 3,160ft; range A (max payload), 600 n.m.; range B (max fuel), 1,550 n.m.; corres payload, 7,570lb.

F.27 Mark 400 Freightship/Combiplane

Powerplant: As Mk 200.

Dimensions: As Mk 100.

Weights: As Mk 200 except capacity payload, 12,962lb; weight less fuel, crew and payload, 22,230lb.

Payload accommodation: As Mk 300.

Performance: Optimum-cost cruise speed at 20,000ft and 35,000lb, 264kt; corres specific fuel consumption, 0.1805 n.m./lb; take-off field length at 37,500lb, 3,450ft; landing field length at 37,500lb, 3,160ft; range A and B as Mk 200.

F.27 stretched version "Long Friendship"

Powerplant: As Mk 200.

Dimensions: As Mk 100 except length, 82ft 1in.

Weights: As Mk 200 except max landing, 39,500lb; zero fuel, 38,500lb; capacity payload, 14,272lb; weight less fuel, crew and payload, 23,500lb.

Payload accommodation: Cabin volume, 2,360 cu ft; baggage and freight volume, 305 cu ft; cabin accommodational length, 33ft 9in; max usable floor area, 352 sq ft; dimensions of larger door as Mk 300; 44 seats at 35½in pitch.

Fuel capacity: As Mk 100.

Performance: Optimum-cost cruise at 20,000ft and 35,000lb, 256kt; corres specific fuel consumption, 0.1748 n.m./lb; take-off field length at 37,500lb, 3,450ft; landing field length at 37,500lb, 3,160ft; range A (max payload) 540 n.m. (620 st.m.); range B (max fuel), 1,520 n.m. (1,750 st. m.); corres payload, 8,600lb.

F.28 This is a project for a small twin-jet development of the F.27, of approximately the same capacity. One possible powerplant is the Bristol Siddeley BS.75.

HANDLEY PAGE *Cricklewood, London NW2.*

H.P.81 Hermes 4 Developed from the H.P.68 Hermes 1 prototype of 1945, through the experimental Hermes 2, the Hermes 4 was the first British four-engined airliner of post-war design to enter service with BOAC. It was used extensively on the corporation's African routes from March 1950, and a total of 25 were built, all for BOAC. This fleet was sold to various British independents.

Powerplant: Four Bristol Siddeley Hercules 763 of 2,100 b.h.p. each driving 13ft de Havilland four-bladed propellers.

Dimensions: Span, 113ft; length, 96ft 10in; height, 30ft; gross wing area, 1,408 sq ft.

Weights: Max take-off, 86,000lb; landing, 75,000lb; capacity payload, 17,000lb; empty, 51,655lb.

Payload accommodation: Baggage and freight volume, 452 cu ft; cabin length, 44ft 5in; max width, 10ft 3in; max seats, 74.

Fuel capacity: 3,206 Imp gal.

Performance: Max weak mixture cruising speed, 232kt (266 m.p.h.) at 20,000ft; take-off distance to 50ft, 4,086ft; landing distance from 50ft, 3,375ft; payload for max range, 6,349lb; a 14,400lb payload can be carried 1,740 n.m. (2,000 st.m.) at 240kt (276 m.p.h.) at 20,000ft.

H.P.R.3 Herald Series 100 and 200 Designed as a private-venture replacement for the DC-3, the Herald prototype, powered by four 825 b.h.p. (max take-off) Alvis Leonides Major 701 piston engines, made its first flight on August 25, 1955; the second prototype took to the air just over a year later. Increasingly wide acceptance of the Rolls-Royce Dart led to the piston-engined version eventually being abandoned in favour of the Dart Herald, announced in May 1957.

The first prototype Herald was re-engined with two Darts and made its first flight in this form on March 11, 1958, and the second prototype was similarly re-engined. This aircraft, G-AODF, and the first production aircraft have been demonstrated in Greece, Turkey, Persia, Pakistan, India and Ceylon as well as in Central and South America, Australia, New Zealand and the Far East.

Under an arrangement announced by the Government in June 1959, three Dart Heralds were to be purchased by the Government at a cost of some £750,000, including spares and crew training. These are to be operated by BEA for an initial five-year period over Scottish routes where the aerodromes are too small for Viscounts. The three aircraft (Series 100) for BEA are due to be delivered towards the end of the year (during February of 1962 two BEA Heralds are to be used by H.R.H. the Duke of Edinburgh during his tour to 11 South American countries). The original plan was that BEA would buy these three aircraft from the MoA at the end of a five-year period. Dart Heralds have been certificated at a gross weight of 40,000lb which can be maintained up to ISA + 13°C. At ISA + 30°C maximum weight is 39,100lb. Handley Page have announced that the weight is to be increased to 43,000lb. Dart Heralds have now flown some 3,000 hours.

Herald Series 100

Powerplant: Rolls-Royce RDa.7/2 Dart 527 turboprops of 2,100 e.h.p. each driving 12ft 6in Rotol four-bladed propellers.

Dimensions: Span, 94ft 9in; length, 71ft 11in; height, 24ft; wing area, 886 sq ft.

Weights: Max take-off, 40,000lb; max landing, 39,500lb; zero fuel, 36,000lb; capacity payload, 13,300lb (freighter) or 10,160lb (38-passenger version); basic operational, 24,480lb.

Payload accommodation: Cabin volume, 2,198 cu ft; cabin length, 48ft 9in; max width, 8ft 8in; max height, 6ft 5in; usable floor area, 260 sq ft; dimensions of largest entrance, 64in × 65in; max seats, 48.

Fuel capacity: 1,080 Imp gal plus 53 Imp gal water-methanol.

Performance: Cont cruising speed, 237kt (272 m.p.h.) at 20,000ft and 36,500lb, with a fuel consumption of 184 Imp gal/hr; balanced field length at max take-off weight, sea level, ISA, 4,100ft; at sea level, ISA + 15°C, 4,700ft; at 5,000ft, ISA and 36,850lb, 5,700ft; landing distance (from over 50ft obstacle, max landing weight), 2,275ft; range A (max payload), 750 n.m. (862 st.m.) with 38 passengers; range B (max fuel), 1,500 n.m. (1,725 st.m.) with 6,700lb payload at 266kt at 23,000ft.

Herald Series 200

On September 7, 1960, HP announced that Jersey Airlines had placed an order for six Series 200 Heralds, two for delivery in June 1961, two in June 1962, and two in June 1963. Value of the contract is about £1.75m excluding spares. Maritime Central Airways and Nordair Ltd of Canada have 4 Series 200 Heralds on order with an option on two more. At the 1961 SBAC display Itavia, Italy's only independent scheduled operator, signed a contract for two Series 200 Heralds with an option on one more. The Series 200 has a 42in fuselage stretch forward of the wing, permitting a 50-56 seat layout, compared with 44-48 in the Series 100. An executive version of the Herald is also available with interior layout to suit customer requirements. A rear under-

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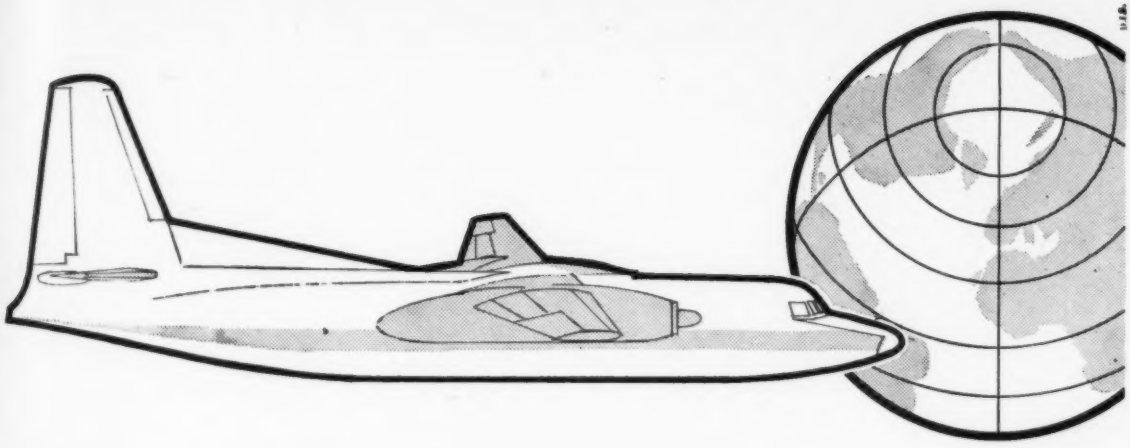

FRIENDSHIP OF NATIONS

Fokker

Through the centuries wise fellows like Socrates and Homer and Shaw discussed the art of being careful about friendships and money. Of course you agree.

If you buy anything, from a pin to an aircraft, you're smart to insist on something of proven value and proven quality. The people who build the Fokker F.27 Friendships have you in mind. Into the Friendship has been built economy, adaptability and money-earning capacity. The F.27 flies over deserts, pampas and water, in all climatic and geographical conditions, with complete dependability, comfort, and at the lowest possible seat mile cost.

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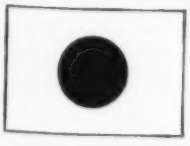
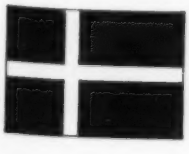
As T.H. Davies, president of the American Piedmont Airlines says: "the F.27 is the most efficient and economical short range transport aircraft available today". In five continents the Friendship of nations builds business.

IN ANY LANGUAGE

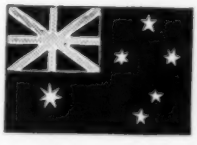


すべからく友と金とは得つべきである。然も前者は宝石であり又金以上のものである。



Man skal knytte venskaber og tjene penge, men anvende begge med omtanke. Venskaber er juveler, og det er en større kunst at bevare disse end skaffe nye.

Un homme doit se faire, dans l'ordre, des amitiés puis de l'argent et de les employer sagement. Les amitiés sont des joyaux et c'est un plus difficile art de les conserver que d'en faire d'autres.



A man should make friends and money, in that order, and use both wisely. Friendships are jewels and there is more art in saving than gaining.

C

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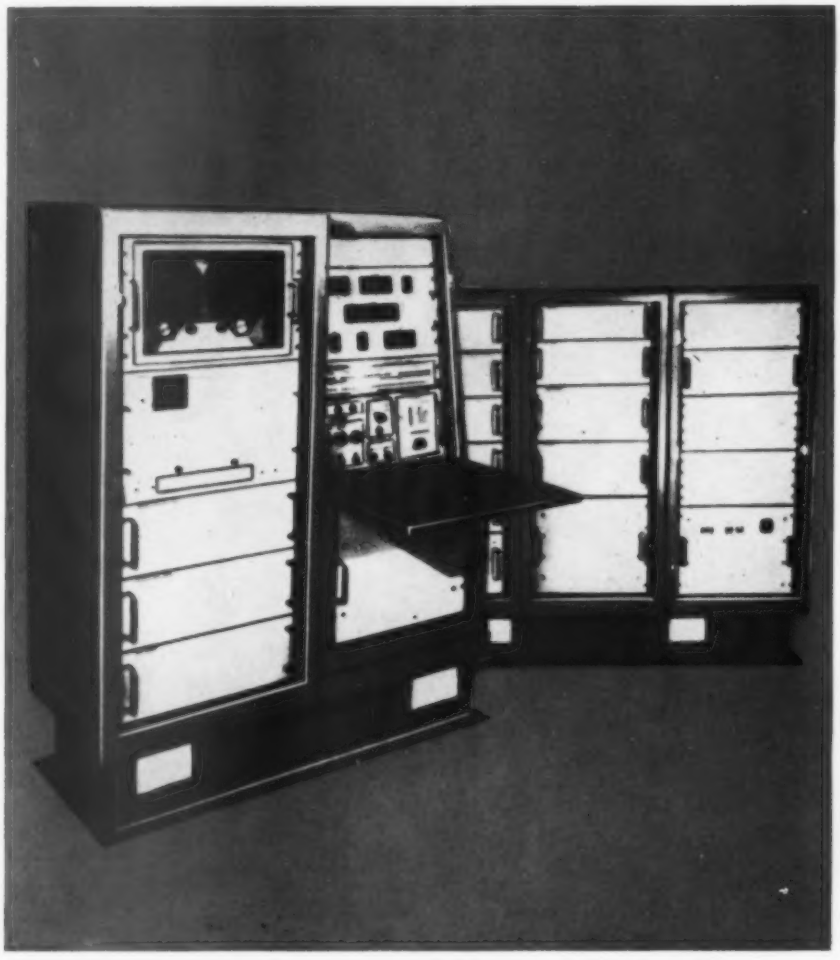

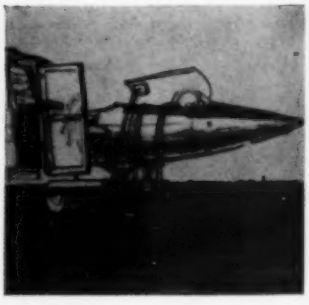

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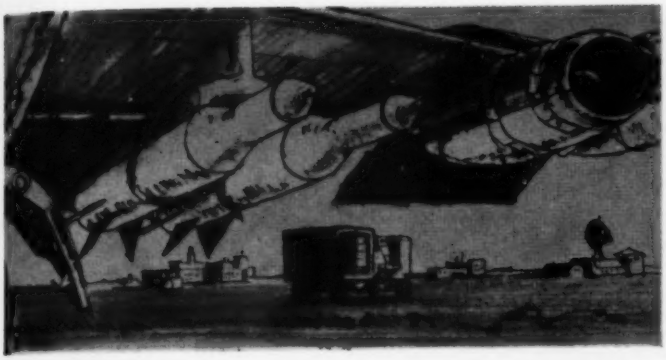

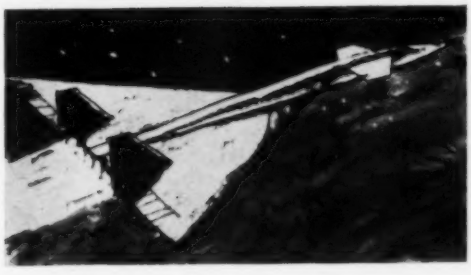

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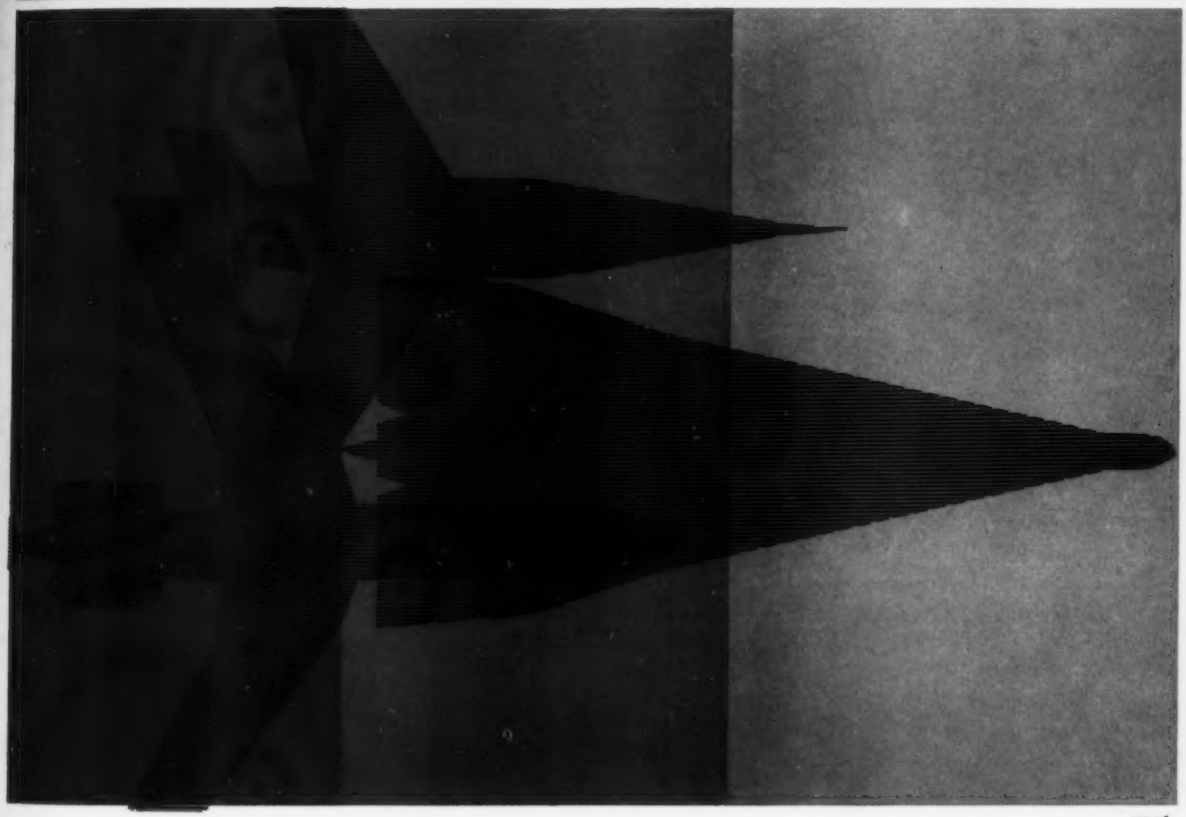

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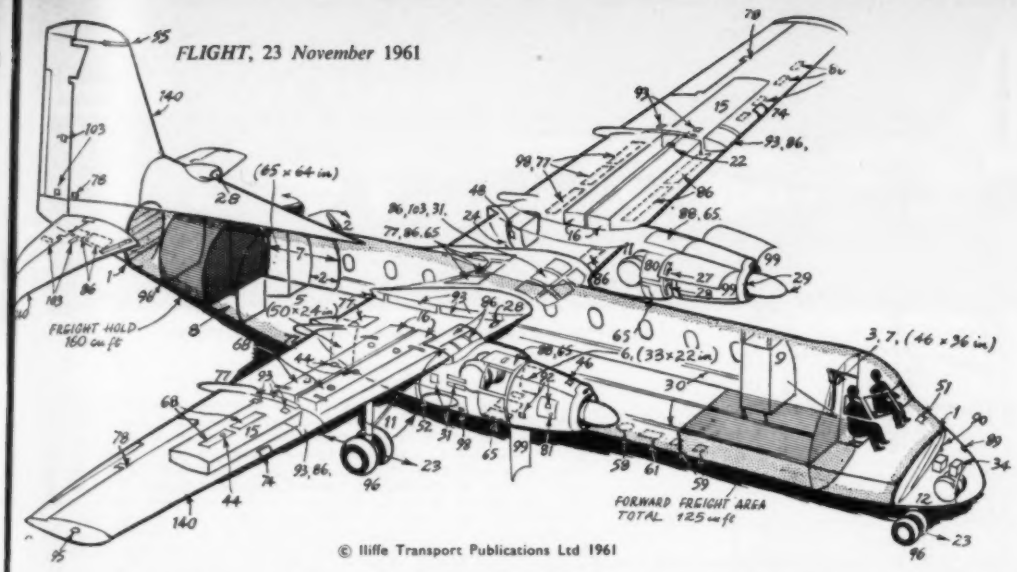

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HANDLEY PAGE HERALD 200 *"Flight" operators' reference drawing—see page 800 for key*

Commercial Aircraft of the World . . .

tail loading version with maximum weight of 46,000lb will shortly be available. Recently a military version of the Herald Series 200 was evaluated by Service chiefs.

Powerplant: As Series 100.

Dimensions: As Series 100 except length, 75ft 6in.

Weights: Max take-off, 40,000lb; max landing, 39,500lb; zero fuel, 37,000lb; capacity payload, 11,746lb; weight less fuel, crew and payload, 24,715lb.

Payload accommodation: Cabin volume (less flight deck), 2,415 cu ft; baggage and freight volume, 285 cu ft; cabin accommodational (50-seat version) length, 34ft 7in; max internal width, 8ft 8in; max height, 6ft 5in; max usable floor area (less flight deck), 290 sq ft; dimensions of largest door, 64in × 65in; max number of seats with galleys, 50 at 30.5in pitch.

Fuel capacity: As series 100.

Water-methanol capacity: As Series 100.

Performance: Opt-cost (i.e., typical cruising speed) at 15,000ft and 36,000lb, 238kt; corres s.f.c., 0.136 n.m./lb; take-off field length, max take-off weight, sea level, ISA, zero wind, engine failure at V_1, 4,500ft; landing field length, sea level, ISA, zero wind, 3,750ft; range A (max payload), 475 n.m.; range B (max fuel), 1,420 n.m. with 6,060lb; V_{NE}, 237kt IAS; V_{NO}, 204kt IAS; V_{SO}, 71kt IAS.

Herald Freighter This is not the commercial version of the Military Herald with rear-loading (announced in September 1961), but a version of the Series 200 Herald. Data are the same, except for: capacity payload, 13,489lb; weight less fuel, crew and payload, 23,137lb; cabin volume, 2,700 cu ft; cabin accommodational length, 54ft 6in.

H.P.R.8 A vehicle ferry based on the Herald, this project has a revised fuselage with front clamshell doors. It can accommodate six cars and 30 passengers, or 100 passengers.

HUREL-DUBOIS *Boite Postale No 6, Meudon, France.*

HD-321 The remarkable Hurel high aspect-ratio strutted wing was developed to provide great lifting capacity (through a high L/D ratio) for low weight and cost. The first Hurel-Dubois transport prototype was the HD-31, which made its first flight on January 27, 1953; a developed and more powerful version, the HD-32, flew in prototype form on December 29 the same year, and a second prototype followed in February 1954. Later, both HD-32 prototypes were re-engined with Wright Cyclones as replacements for the Pratt & Whitney Twin Wasps fitted earlier, and the first flight in this HD-321 configuration was made on December 22, 1955. Six derivatives—HD-34s—have been delivered to the Institut Géographique National. *Flight* reference also to HD-37 car ferry project, November 20, 1959, page 609. Smaller derivatives, the HD-150 and HD-151, have been projected for military STOL application in competition with the Dassault Spirale, Max Holste Super Broussard, and Breguet 945. Powerplant would be two Turboméca Autan III.

ILYUSHIN

Il-12 Considerable numbers of these unpressurized 27-passenger transports, with nosewheel undercarriage, continue in service.

Il-14 There are two principal variants of this Il-12 development. The Il-14P, seating 18 or 26 passengers, is standard. It is produced not only in the Soviet Union but in East Germany and by Avia in Czechoslovakia. The Il-14M has a fuselage lengthened by 3.3ft and seats 24 to 32 passengers.

Powerplant: Two ASh-82T piston engines, of 1,900 h.p. each, driving four-blade constant-speed propellers.

Dimensions: Span, 104ft; length (Il-14P), 69ft 11in; length (Il-14M), 73ft 4in.

Weights: Take-off (Il-14P), 36,400lb; empty, 26,600lb; take-off (Il-14M), 38,000lb; empty, 27,000lb.

Performance: Cruising speed (Il-14P), 173-188kt (200-217 m.p.h.); cruising speed (Il-14M), 173-191kt (200-220 m.p.h.); take-off run (Il-14P), 1,540ft; take-off run (Il-14M), 1,476ft; range (Il-14P), 1,150 miles approx; range (Il-14M), 950 miles approx.

Il-18 In its issue of July 1, 1960, *Flight* presented, for the first time in any aviation journal, a detailed technical description of this important turboprop airliner. The type is in extensive service with Aeroflot and also with the East German DLH; CSA, the Czech state airline, Ghana Airways, the Chinese civil air fleet, Tarom of Rumania, and Malev of Hungary.

Powerplant: Four Ivchenko AI-20 turboprops of 4,000 e.h.p., driving AB-68I 14ft 9in reversible and braking propellers.

Dimensions: Span 122ft 8¼in; length, 117ft 9in; height, 33ft 4in; wing area, 1,507 sq ft.

Weights: Max take-off, 135,584lb; max payload, 30,865lb.

Payload accommodation: Total pressurized volume, 8,475 cu ft; forward under-floor cargo hold, 470 cu ft; rear under-floor hold, 483 cu ft. Additionally there is an unpressurized baggage compartment of 250 cu ft capacity to the rear of the main cabin. Dimensions of passenger doors, 4ft 7in × 2ft 6in; max seats, 111 (six abreast).

Fuel capacity: Total, 5,213 Imp gal (6,260 US gal).

Performance: Cruising speed at 26,000ft, 388-404 m.p.h. (338-351kt); max range (no reserves), 3,300 n.m. (3,480 st.m.); take-off run, 2,625-3,940ft; landing run, 1,970-2,300ft.

Operators' reference drawing of Il-18: page 825.

The Il-18, in large-scale service with Aeroflot, is the only Russian airliner operated by a Commonwealth country

Eastern was the first carrier to inaugurate Lockheed Electra services

Commercial Aircraft of the World . . .

JAPAN See under NAMC.

LOCKHEED *Lockheed Aircraft Corporation, Burbank, California, USA.*

L.10 Design work began on the all-metal L.10 Electra, a twin-engined eight to ten-passenger monoplane, in 1932. It was obviously inspired by the success of the first two "modern-type" transports, the Boeing 247 and Douglas DC-1 but, being smaller, it was not directly competitive. The Electra's first flight was on February 23, 1934, and the type went into service with North West Airways soon afterwards. It was later supplied to Pan American, Eastern, Braniff, Delta and others. A total of 149 were built and 28 remain in service today with 11 operators.

The Electra was succeeded by the L.12, L.14 and L.18 which were built in considerable numbers before and during the War. A few of each of these types remain in airline service today. *Flight* reference: see November 20, 1959, for data.

L.049 The result of discussions in the summer of 1939, the Constellation owed something of its general layout to a four-engined, short-haul project, the L.44 Excalibur, but was much larger, being designed to carry 40 passengers across North America non-stop. The first flight was made on January 9, 1943, and 73 of a military version were ordered by the US Army Air Force. It went into limited use in mid-1944, but the Constellation did not reach airline service until after the War —with TWA in February 1946. Thereafter, a total of 88 were built of the first version—all of which had originally been ordered as military aircraft. Some 66 of these are still in service. The L.049 at first cost about $700,000 (£170,000) but later this was increased to about $800,000 (£200,000). Current price is about £46,000.

Powerplant: Four 2,200 h.p. Wright R-3350-C18-BA-3s driving Hamilton Standard Hydromatic 33E60-41/6801A 15ft 2in propellers.

Dimensions: Span, 123ft; length, 95ft 2in; height empty, 22ft 5in; wing area, 1,650 sq ft.

Weights: Max take-off, 98,000lb; landing, 83,000lb; zero fuel, 81,464lb; capacity payload, 18,423lb; weight less fuel and payload, 60,367lb.

Payload accommodation: Cabin volume, 3,000 cu ft; baggage and freight volume, 434 cu ft; cabin length, 64ft 9in; max width, 10ft 8.6in; max height, 6ft 6in; max usable floor area, 561 sq ft; dimensions of largest door, 2ft 3in × 6ft; max seats, 81.

Fuel capacity: 3,970 Imp gal (4,770 US gal).

Performance: Cont cruising speed, 272kt (313 m.p.h.) at 20,000ft and 83,000lb; corres consumption, 370 Imp gal/hr; balanced field length, 4,800ft; at SL, ISA + 15°C, 5,016ft; at 5,000ft, ISA, 5,710ft; landing distance from 50ft, 4,050ft; range A (max payload), 1,970 n.m. (2,260 st.m.); range B (max fuel), 3,470 n.m. (4,000 st.m.); corres payload, 10,283lb; corres cruise speed, 235kt (270 m.p.h.).

L.749 In 1946 Lockheed produced the first purely civil Constellation. This was the L.649 which had improved accommodation standards and was known as the "Gold Plate" Constellation. It flew for the first time on October 19, 1946, and went into service with Eastern Air Lines in May 1947. The L.749 followed the 649. It was similar but had more fuel tankage. The first were delivered later in 1947 and many 649s were later converted to 749 standard. The 749A is the same basic aircraft but is cleared to operate at higher weights. A total of 145 L.649, 749 and 749As were built (plus 12 of a military version) and 123 are still in service. New price in 1950 was $970,000 (£345,000). Current market price (L.749A): under £100,000.

Powerplant: Four 2,500 h.p. Wright R-3350-C18-BD1s driving Hamilton Standard Hydromatic 43E60/6801A 15ft 2in propellers.

Dimensions: As L.049.

Weights: Max take-off, 107,000lb; landing, 89,500lb; zero fuel, 86,464lb; capacity payload, 20,276lb; weight less fuel and payload, 65,074lb.

Payload accommodation: As L.049.

Fuel capacity: 4,920 Imp gal (5,910 US gal).

Performance: Cont cruising speed, 264kt (304 m.p.h.) at 20,000ft and 104,000lb; corres fuel consumption, 385 Imp gal/hr: balanced field length, 4,850ft; at SL, ISA + 15°C, 5,100ft; at 5,000ft, ISA, 6,920ft; landing distance from 50ft, 4,670ft; range A (max payload), 3,300 n.m. (3,800 st.m.); range B (max fuel), 2,410 n.m. (4,840 st.m.); corres payload, 8,026lb; corres cruising speed, 230kt (264 m.p.h.).

L.1049C The prototype Super Constellation flew for the first time on October 13, 1950. It had a fuselage 18ft longer, a max take-off weight raised to 120,000lb and was powered by up-rated engines of 2,700 h.p. giving a total increase of 800 h.p. The original production Super Constellations were the L.1049s delivered to Eastern Air Lines and were put into service in November 1951; a total of 24 were built for Eastern and TWA. Lockheed later received an order from the US Navy for a developed version of the Super Constellation to be powered with the new Wright R-3350 Turbo-Compound engine of 3,250 h.p. The civil version of the naval Super Constellation was known as the L.1049C and was ordered by TWA in 1950. It flew for the first time on February 17, 1953, and entered service in the following June. It was subsequently ordered by several other operators and was followed in production by the improved D and E versions. A total of 102 L.1049/L.1049E were built (plus about 320 equivalent military models) and 87 are still in service with 12 airlines. New price in 1957 was $650,000 (£230,000).

L.1049G The success of the 1049C, which had been the first civil aircraft with the 3,250 h.p. Wright Turbo-Compound engine, encouraged Lockheed to produce a series of further developments. The last and most important were the 1049G and H. The "Super G," as it is widely known, first flew on December 7, 1954, and entered service in January 1955 with Northwest Airlines. A total of 104 were subsequently built and 101 are still in service with 16 airlines. The 1049G is primarily a long-haul aircraft, fitted with wing tip fuel tanks. The 1049H is a freighter version of which 53 were built; 50 are still in service with 12 airlines. New price was $1,920,000 to $2,070,000 (£680,000 to £740,000). Current used asking price, £250,000.

Powerplant: Four 3,400 h.p. Wright R-3350-972-TC-18-DA-3, EA-3 or EA-6 Turbo-Compound engines driving Hamilton Standard Hydromat'c 15ft 2in propellers.

Dimensions: Span, 123ft; length, 113ft 7in; height empty, 24ft 9.4in.

Weights: Max take-off, 137,500lb; landing, 113,000lb; zero fuel, 103,500lb; capacity payload, 24,293lb; weight less fuel and payload, 79,237lb.

Payload accommodation: Cabin volume, 4,800 cu ft; baggage and freight volume, 694 cu ft; cabin length, 83ft 2 in; max width, 10ft 9in; max height, 6ft 6in; max usable floor area, 744 sq ft; dimensions of largest door, 27in × 72in; max seats, 99.

Fuel capacity: 6,550 Imp gal (with tip tanks) (7,870 US gal).

Performance: Cont cruising speed, 270kt (310 m.p.h.) at 20,000ft and 131,000lb; corres fuel consumption, 370 Imp gal/hr; balanced field length, 5,800ft; at SL, ISA + 15°C, 6,340ft; at 5,000ft, ISA, 7,800ft; landing distance from 50ft, 5,270ft; range A (max payload), 3,620 n.m. (4,160 st.m.); range B (max fuel), 4,185 n.m. (4,810 st.m.); corres payload, 18,315lb; corres cruise speed, 243kt.

L.1649A Lockheed decided in 1954 to produce a final development of the Constellation series which would have a similar, or greater, range than the Douglas DC-7C. Lockheed's modification of the Constellation consisted of an entirely new wing of increased span and aspect ratio as well as a fuselage stretched a further 2ft 7in. The new aircraft, which was known as the L.1649A, flew for the first time on October 10, 1956, and went into service with TWA (as the Jetstream) in May 1957. Although the new wing gave the 1649 even more range than the DC-7C, the extra design work and the later start proved a serious handicap and only 43 L.1649As were sold. There are 42 in the hands of TWA, Lufthansa and Air France. The 1649A originally cost about $2,500,000 (£900,000) but this price was later reduced to $2,350,000 (£840,000). *Flight* reference: July 6, 1956.

Powerplant: Four 3,400 h.p. Wright R-3350-TC-18-EA-2 Turbo-Compounds driving three-blade Curtiss C.634S-C602 16ft 10in propellers.

Dimensions: Span 150ft; length, 116ft 1.6in; height empty, 23ft 4.8in; wing area, 1,850 sq ft.

Weights: Max take-off, 160,000lb; landing, 123,000lb; zero fuel, 116,000lb; capacity payload, 23,000lb; weight less fuel and payload, 91,806lb.

Payload accommodation: Cabin volume, 4,875 cu ft; baggage and freight volume, 593 cu ft; cabin length, 85ft 9in; max width, 10ft 9in; max height, 6ft 6in; max usable floor area, 744 sq ft; dimensions of largest door, 27in × 72in; max seats, 99.

Fuel capacity: 7,990 Imp gal (9,600 US gal).

Performance: Cont cruising speed, 281kt (323 m.p.h.) at 20,000ft and 123,000lb; corres fuel consumption, 417 Imp gal/hr; balanced field length, 6,250ft; at SL, ISA + 15°C, 6,534ft; at 5,000ft, ISA, 8,280ft; landing distance from 50ft, 6,000ft; range A (max payload), 4,700 n.m. (5,400 st.m.); range B (max fuel), 5,460 n.m. (6,280 st.m.); corres payload, 10,777lb.

L.188 Electra The Electra was designed to meet a specification issued to the US aircraft industry in January 1955 by American Airlines. The Lockheed project was chosen, and American ordered 35 in June 1955. The specification called for a transport with optimum economics over short and medium stages—a specification for what was loosely termed "a DC-6B replacement," and Lockheed's experience with the T56-

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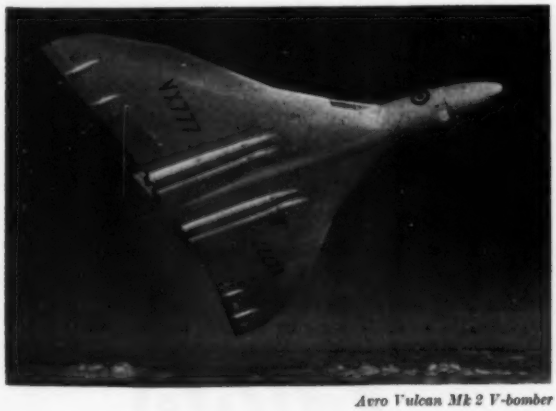

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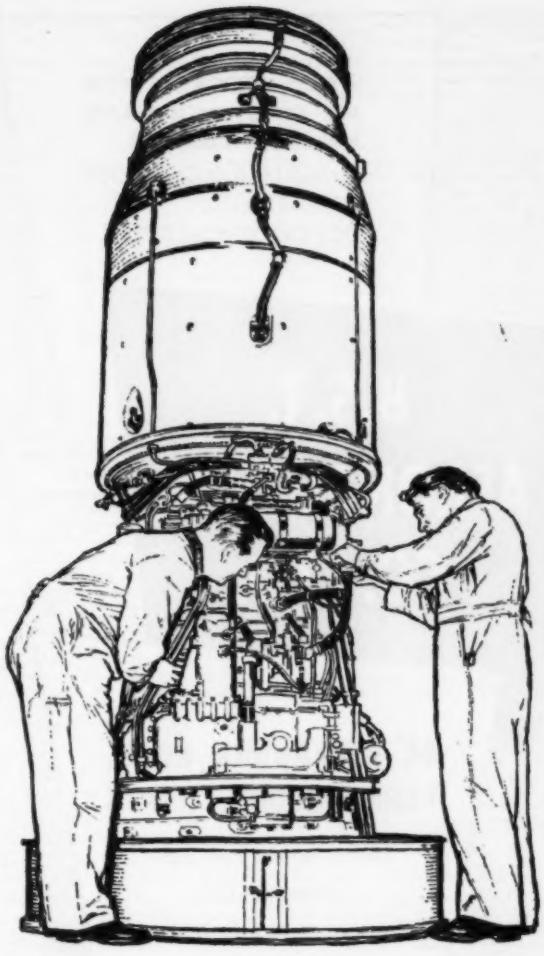

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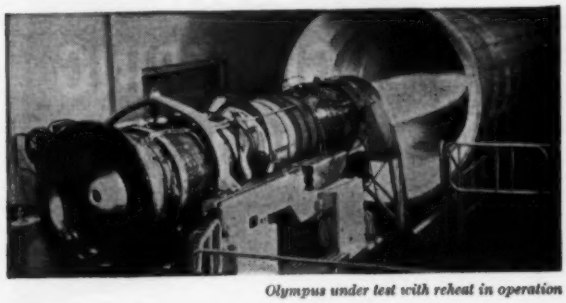

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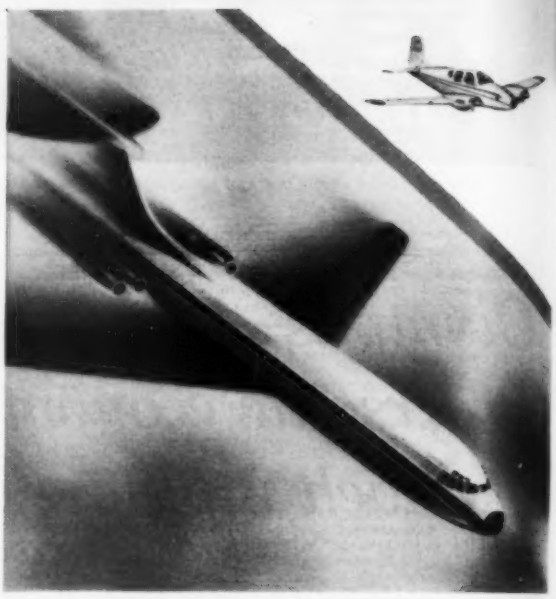

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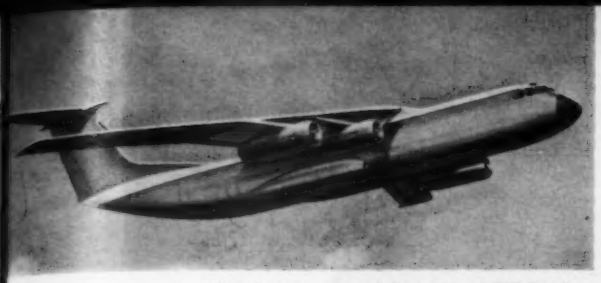


Artist's impression of the Lockheed 300 freighter

Commercial Aircraft of the World . . .

powered C-130 of 1954 encouraged them in the choice of turboprop propulsion.

The first Electra flew on December 6, 1957, and flight tests culminated in FAA certification on August 22, 1958. The first airline to take delivery, in October 1958, was Eastern, who inaugurated the first scheduled services between Miami and New York on January 12, 1959. American's first services were on January 23, 1959.

To date 140 Electras have been delivered to 13 airlines and the order book (accounting for 162 aircraft for 14 airlines) is as follows (*number delivered in parenthesis*): American, 35 (35); Eastern, 40 (40); Braniff, 9 (9); Cathay Pacific, 2 (2); KLM, 12 (10); Western, 12 (6); National, 14 (12); Pacific Southwest, 4 (3); Ansett/ANA, 3 (3); Garuda, 3 (0); Northwest, 18 (10); Qantas, 4 (4); Trans-Australia, 3 (3); TEAL, 3 (3); Allison, 1 (for development); US Navy, 1 (converted into Y/P3V-1 prototype).

Now completed is an extensive "product improvement" programme for the incorporation of revisions in the design found necessary as a result of two accidents (the first to a Braniff aircraft in September 1959, the second to a Northwest aircraft in March 1960). The modifications have been restrospectively made to all speed-restricted delivered aircraft, which have been returned to Lockheed progressively. Main rework is to the powerplant mounting structure. The fault is fully established and has been rectified.

The L.188C has increased tankage and 116,000lb max weight (initial aircraft were certified at 113,000lb). KLM were the first recipients of the "C," which is the standard aircraft.

Basic price: £928,000. *Flight* references; July 25,1958; November 1, 1957; July 6, 1956. An operator's reference drawing appears on page 825.

The following data apply to the L.188C:—

Powerplant: Four Allison 501-D13 turboprops of 3,750 e.h.p. each, driving Aeroproducts or Hamilton Standard 13ft 6in propellers.

Dimensions: Span, 99ft; length, 104ft 8in; height, 32ft 10½in; wing area, 1,300 sq ft.

Weights: Max take-off, 116,000lb; landing, 95,650lb; zero fuel, 86,000lb; capacity payload, 26,300lb; weight less fuel and payload, 59,700lb.

Payload accommodation: Cabin volume, 4,812 cu ft; baggage and freight volume, 636 cu ft; cabin length, 76ft 5in; max width, 10ft 8in; max height, 7ft ½in; max usable floor area, 704 sq ft; dimensions of largest door, 77in × 35in passenger, 42in × 52in hold; max seats, 104 at 34in pitch.

Fuel capacity: 5,429 Imp gal (6,520 US gal).

Performance: Cruise speed, 352kt (405 m.p.h.) at 22,000ft and 85,500lb; corres fuel consumption, 4,200lb/hr; balanced field length, max take-off, sea level, ISA, 5,050ft; ISA + 15°C, 6,700ft; 5,000ft, ISA, 7,800ft; landing distance from 50ft; 4,270ft; range A (max payload), 2,110 n.m. (2,430 st.m.); range B (max fuel), 3,140 n.m. (3,610 st.m.); corres range B payload, 16,800lb; cruise Mach number, 0.615; VNE, 364kt (419 m.p.h.); VNO, 324kt (372 m.p.h.).

JetStar Designed to a USAF specification for a ten-passenger light jet transport, the JetStar is now being produced as a very fast eight-seater executive type against orders from a number of business corporations. In an exceptional effort to be first in the field, Lockheed designed and built the first prototype in the eight months prior to the first flight on September 4, 1957. The heavier and more developed production aircraft, the first of which was rolled out in June 1960, are powered by four Pratt & Whitney JT-12-A6s and equipped with thrust reversers. Two 260-gal external fuel tanks are an optional fitting. Orders have been placed by Continental Can Co, Canadian Department of Transport, Ryder System Inc, T. Eaton & Co, Krupps of Essen, and by Jet Executive Transport Services Inc, who might act as sales agents. A small batch has been delivered to the USAF (designated C-140) since September 1961. FAA certification was awarded in August 1961. Basic price: about £487,000, or with de luxe interior, about £434,000. *Flight* references: September 13, 1957; September 20, 1957; December 12, 1958; August 21, 1959; November 20, 1959; and June 10, 1960.

Powerplant: Four Pratt & Whitney JT-12-A6 of 3,000lb static thrust each.

Dimensions: Span, 54ft 5in; length, 60ft 5in; height, 20ft 5in.

Weights: Max take-off, 40,921lb; max landing, 30,000lb; max payload, 2,143lb.

Payload accommodation: Cabin volume, 700 cu ft; max seats, 8.

Performance: Typical cruising speed, 450kt at 30,000ft and 30,000lb; balanced field length, SL, ISA, 7,000ft; range A (max payload), 2,530 n.m. (2,970 st.m.).

Lockheed 300 This is the commercial version of the C-141 strategic freighter ordered by the USAF. Preliminary briefings of interested customers have been under way since July 1961, when first details were released.

Powerplant: Four Pratt & Whitney JT3D-8A turbofans (TF33-P-7) of 21,000lb thrust each.

Dimensions: Span, 160ft 8in; length, 146ft 2in; height empty, 39ft 1in; wing area, 3,228 sq ft; sweepback at quarter chord, 25°.

Weights: Max take-off, 315,000lb; max landing, 257,500lb; capacity payload, 93,000lb; weight less fuel, crew and payload, 125,100lb.

Payload accommodation: Cabin volume (less flight deck), 7,156 cu ft; cabin accommodational length, 78ft; max internal width, 10ft 3in; max height, 9ft 1in; max usable floor area (less flight deck), 805 sq ft; dimensions of largest door, 123in × 109in.

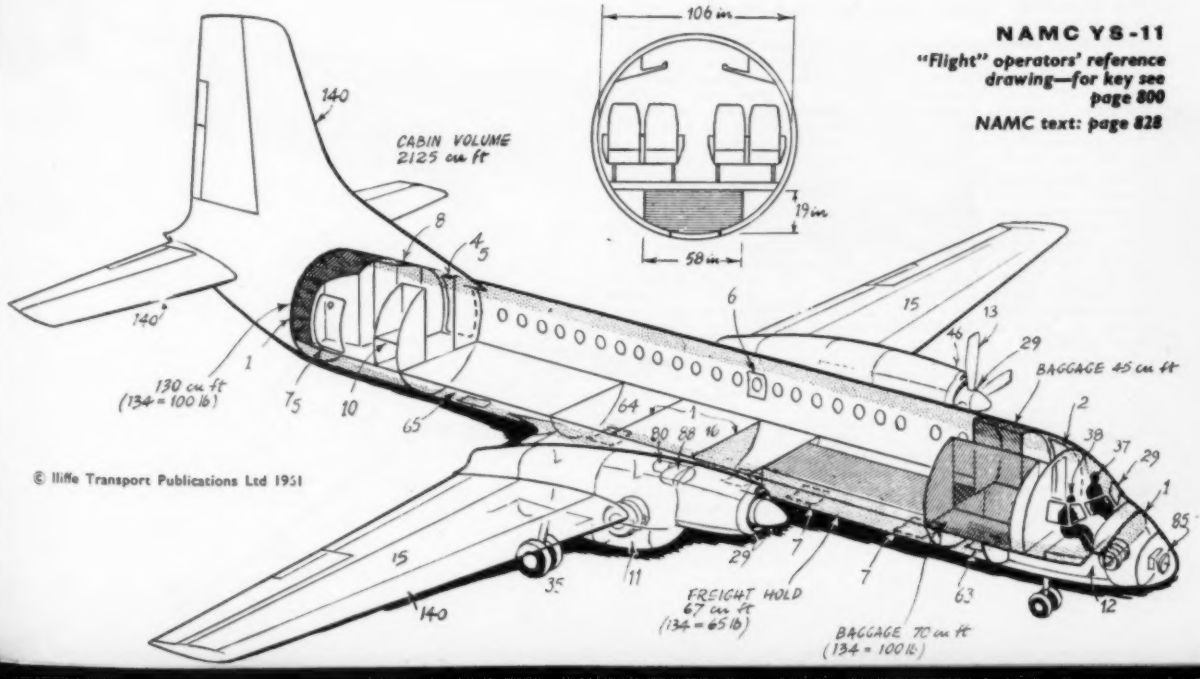
Fuel capacity: 23,080 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 30,000ft and 250,000lb, 440kt (true); corres s.f.c., 0.78lb/hr/lb of thrust; FAA take-off field length, SL, IAS, max weight, 6,000ft; FAA landing field length, SL, max landing weight, 6,250ft; range A (max payload), 4,170 n.m.; range B (max fuel), 6,690 n.m.; corres payload, 39,300lb; cruise Mach number, 0.825; VNE, 440kt IAS; VNO, 350kt IAS; VSO (max weight, 257,500lb), 99kt IAS.

MARTIN *The Martin Company, Baltimore 3, Maryland, USA.*

Martin 2-0-2 First twin-engined airliner of completely post-war design to be approved by the CAA for airline use, the Martin 2-0-2 prototype first flew on November 22, 1946. Like the Convair 240, it was aimed at the DC-3 replacement market, but a number of setbacks early in its career enabled the Convair 240 and its successors to capture most of the market, especially overseas. Unlike the Convair-liners, the Martin 2-0-2 is unpressurized. Only 31 were built, for Northwest, LAN (Chile) and LAV (Venezuela); the last two airlines retain their 2-0-2s but those of Northwest have been disposed of.

Twelve more of an improved version, the Martin 2-0-2A, were sup-



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NAMC YS-11

"Flight" operators' reference drawing—for key see page 800

NAMC text: page 828

The Super Broussard, seen here in Royal Air Maroc colours, is arousing interest as a DC-3 replacement for outback operations

plied to TWA; these are fitted with R-2800-CB16 Double Wasps like the Martin 4-0-4, and have a max take-off weight of 43,000lb and increased fuel tankage. TWA has now withdrawn its 2-0-2As from service. LAN and LAV, with four and two respectively, and Allegheny Airlines and Pacific Air Lines, with eight aircraft each, are the only operators of the Martin 2-0-2 series. Current secondhand market price being asked for 2-0-2s is about £40,000.

Powerplant: Two Pratt & Whitney R-2800-CA18 Double Wasps of 2,400 b.h.p. each with water injection driving 13ft 1in Hamilton Standard three-bladed propellers.

Dimensions: Span, 93ft 3in; length, 71ft 4in; height, 28ft 5 in; wing area, 864 sq ft.

Weights: Max take-off, 39,900lb; capacity payload, 9,270lb; weight empty (equipped), 26,930lb.

Payload accommodation: Baggage and freight volume, 281 cu ft; cabin length, 34ft 8in; minimum width, 9ft; max height, 6ft 7in; max seats, 40.

Fuel capacity: 1,010 US gal.

Performance: Cruising speed, 249kt (286 m.p.h.) at 12,000ft; take-off field length, max take-off weight, 4,000ft; landing distance from 50ft, 1,720ft at 38,000lb weight; range, with allowances, 552 n.m. (635 st.m.) with 36 passengers and baggage plus 1,000lb cargo; max range, 1,760 n.m. (2,020 st.m.).

Martin 4-0-4 The Martin 4-0-4 is a development of the 2-0-2, from which it differs in being pressurized and having a 39in longer fuselage. CAA type certification of the 4-0-4 was granted on October 5, 1951; the prototype, a modified Martin 2-0-2, had made its first flight on October 21, 1950. A total of 103 Martin 4-0-4s were built, 60 for Eastern, 41 for TWA and two military versions, designated RM-1, for the US Coast Guard. Current secondhand market price: £90,000.

Powerplant: Two Pratt & Whitney R-2800-CB16 Double Wasps of 2,400 b.h.p. each with water injection, driving 13ft 1in Hamilton Standard three-bladed propellers.

Dimensions: As Martin 2-0-2, except length, 74ft 7in.

Weights: Max take-off, 44,900lb; max landing, 43,000lb; capacity payload, 11,592lb; manufacturer's weight empty, 29,126lb.

Payload accommodation: Baggage and freight volume, 316 cu ft; cabin length, 37ft 11in; min width, 9ft; max height, 6ft 5½in; forward door dimensions, 32in × 60in; max seats, 40.

Fuel capacity: 1,350 US gal (1,120 Imp gal).

Performance: Cruising speed, 244kt (280 m.p.h.) at 18,000ft and 38,000lb, with 1,200 b.h.p. per engine; take-off field length, max take-off weight, 4,000ft; landing distance from 50ft at max landing weight, 1,750ft; range, with allowances, 805 n.m. (925 st.m.) with 40 passengers and baggage plus 1,000lb cargo; range with max fuel, 2,200 n.m. (2,525 st.m.) at 10,000ft with 5,694lb payload.

MAX HOLSTE *Société Nouvelle des Avions Max Holste, 11 Rue Gosset, Reims, France.*

MH-250 Super Broussard Another light transport with both civil and military applications, the Super Broussard has about twice the capacity and more than twice the power of the Broussard and is described by its manufacturers as a "*camionette volante*" or a feeder liner for 17-23 passengers. It is powered by two Pratt & Whitney R-1340 piston engines of 600 h.p. each, and the first flight was made on May 20, 1959. This particular aeroplane is, in effect, an experimental prototype for the MH-260 Super Broussard. *Flight* reference, November 13, 1959.

MH-260 Super Broussard The prototype of this 20/30-seat local service transport, F-WJDV, first flew on July 29, 1960, and has now completed more than 300hr. Apart from the powerplant, it is generally similar to the MH-250, but the fuselage is about 4ft 7in longer. A batch of 25 is being produced by Nord. Among the operators who have signified their interest in the MH-262 pressurized variant (see below) are Royal Air Maroc, Wien Alaska and BC Airlines of Vancouver. It is expected that the first 260 operator will be the Postale de Nuit French domestic airmail line, an Air France subsidiary, who are thought likely to have six. Price of the MH-260, fully equipped, was a year ago quoted as £86,000.

Powerplant: Two Turboméca Bastan IV turboprops of 986 e.h.p. each driving Ratier Figeac FH 86 three-blade 9ft 6in propellers.

Dimensions: Span, 71ft 10in; length, 59ft 7in; height empty, 23ft 4in; wing area, 592 sq ft.

Weights: Max take-off, 21,600lb; max landing, 20,720lb; zero fuel, 20,500lb; capacity payload, 8,550lb; weight less fuel, crew and payload, 11,610lb (freight version), 12,130lb (passenger version).

Payload accommodation: Cabin volume (less flight deck), 1,193 cu ft; baggage and freight volume, 138 cu ft; cabin accommodational length, 24ft 5in; max internal width, 7ft 2in; max height 5ft 11in; max usable

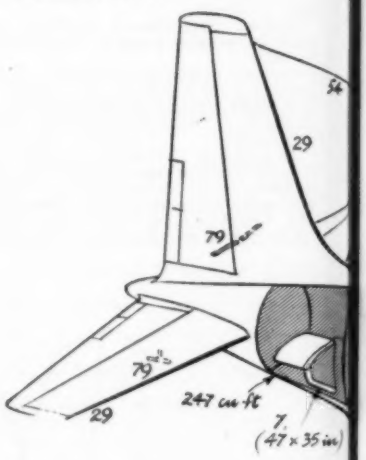
[*Continued on page 828 after double page of illustrations*

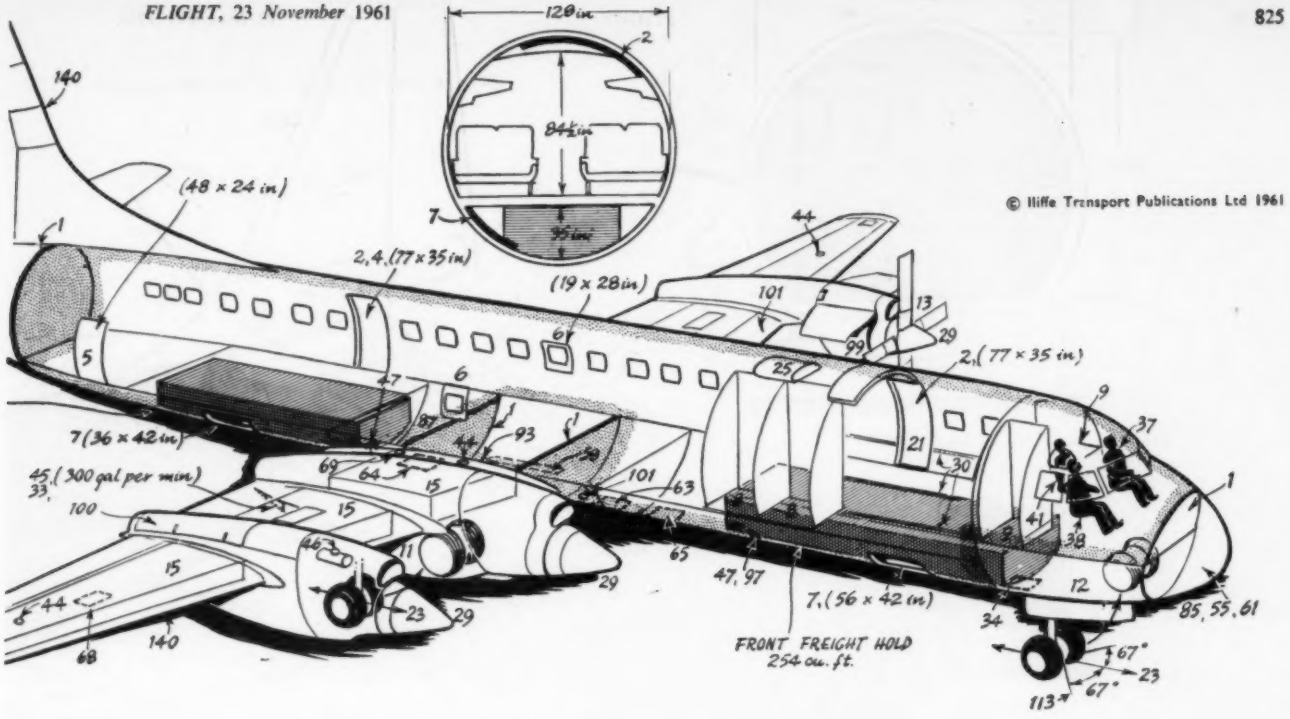
Commercial Aircraft of the World . . .

LOCKHEED ELECTRA

"Flight" operators' reference drawings—for key see page 800

ILYUSHIN Il-18 *(text: page 821)*

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7, (56 × 42 in)
FRONT FREIGHT HOLD
254 cu. ft.
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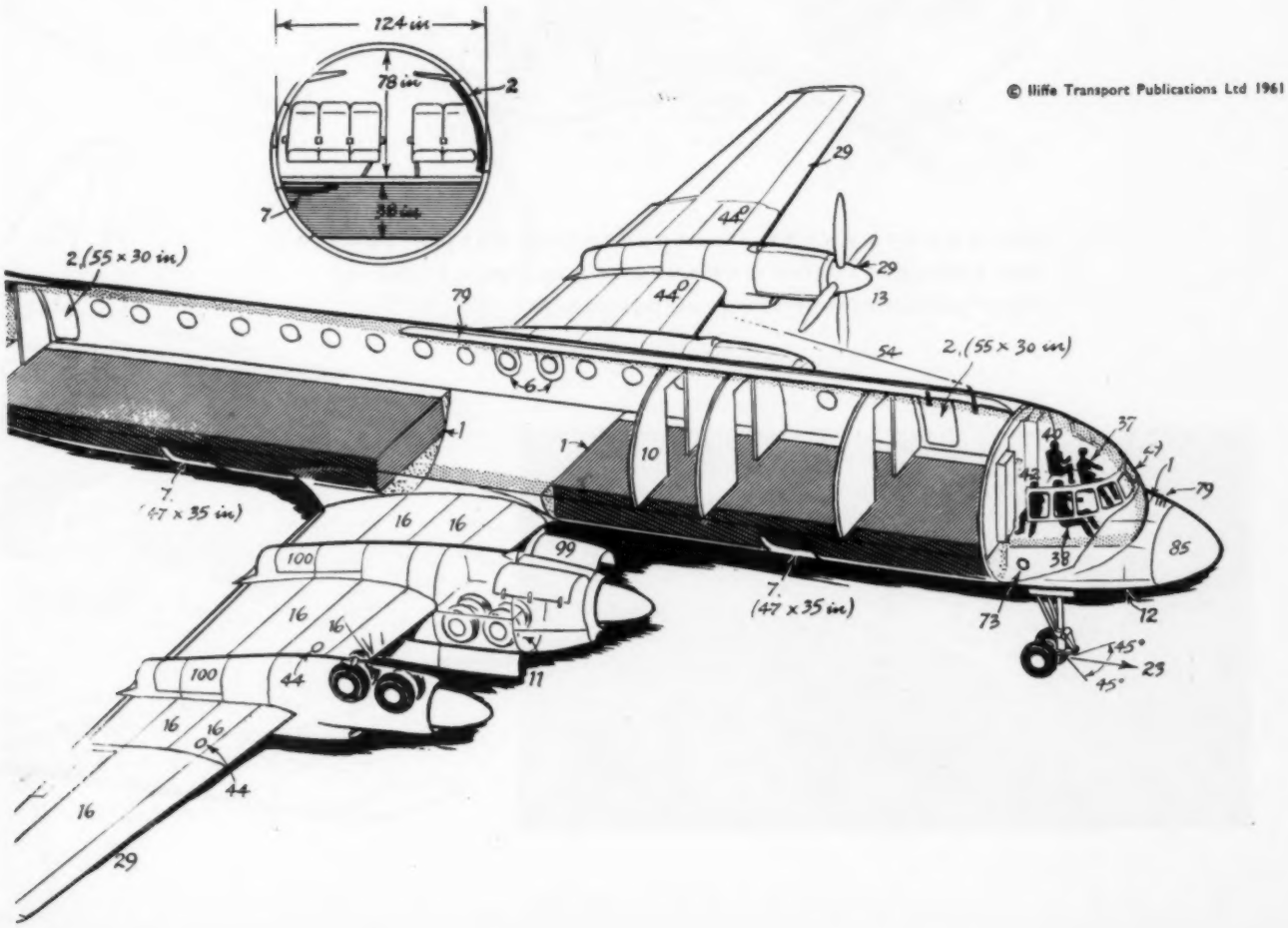
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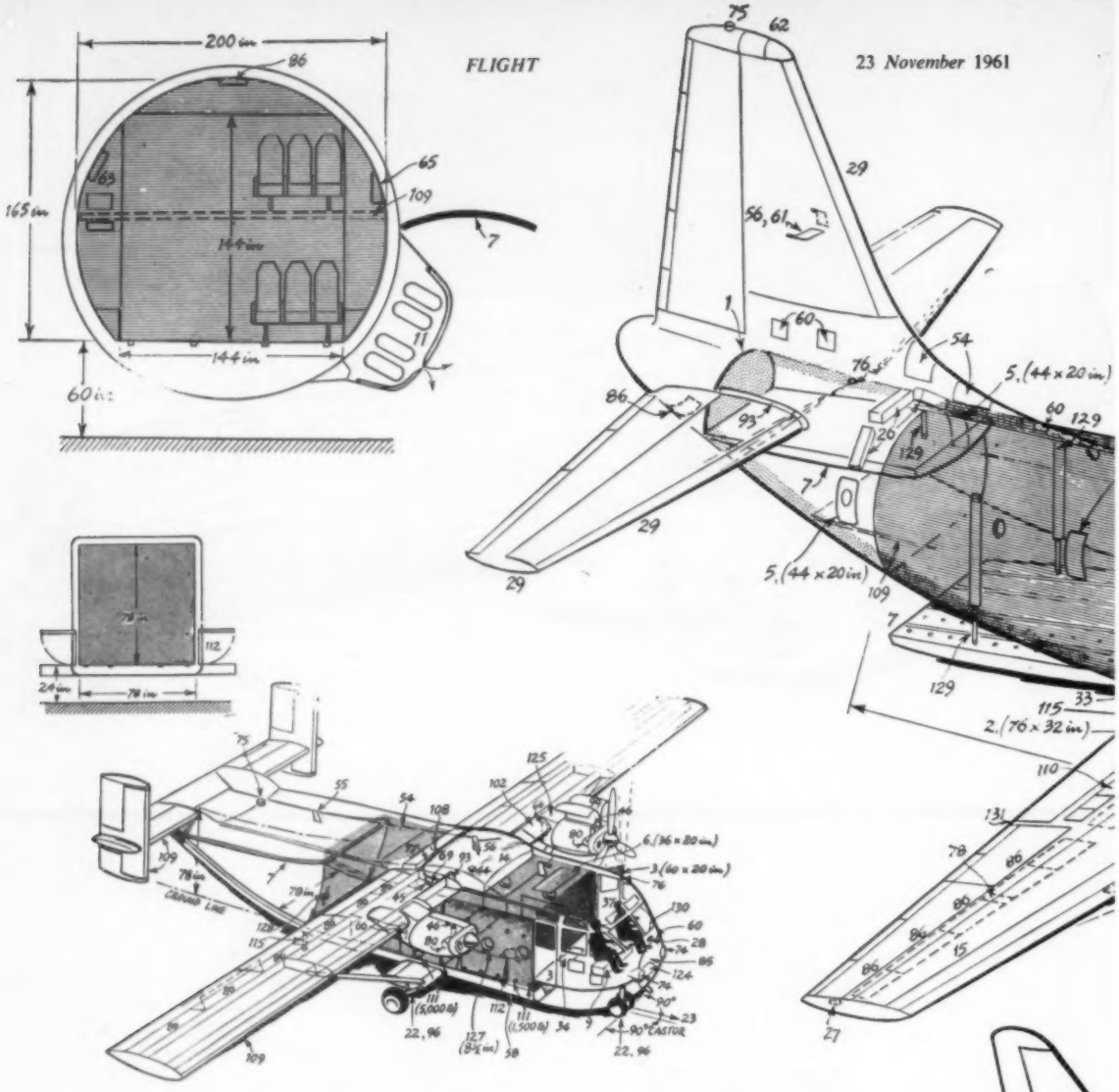
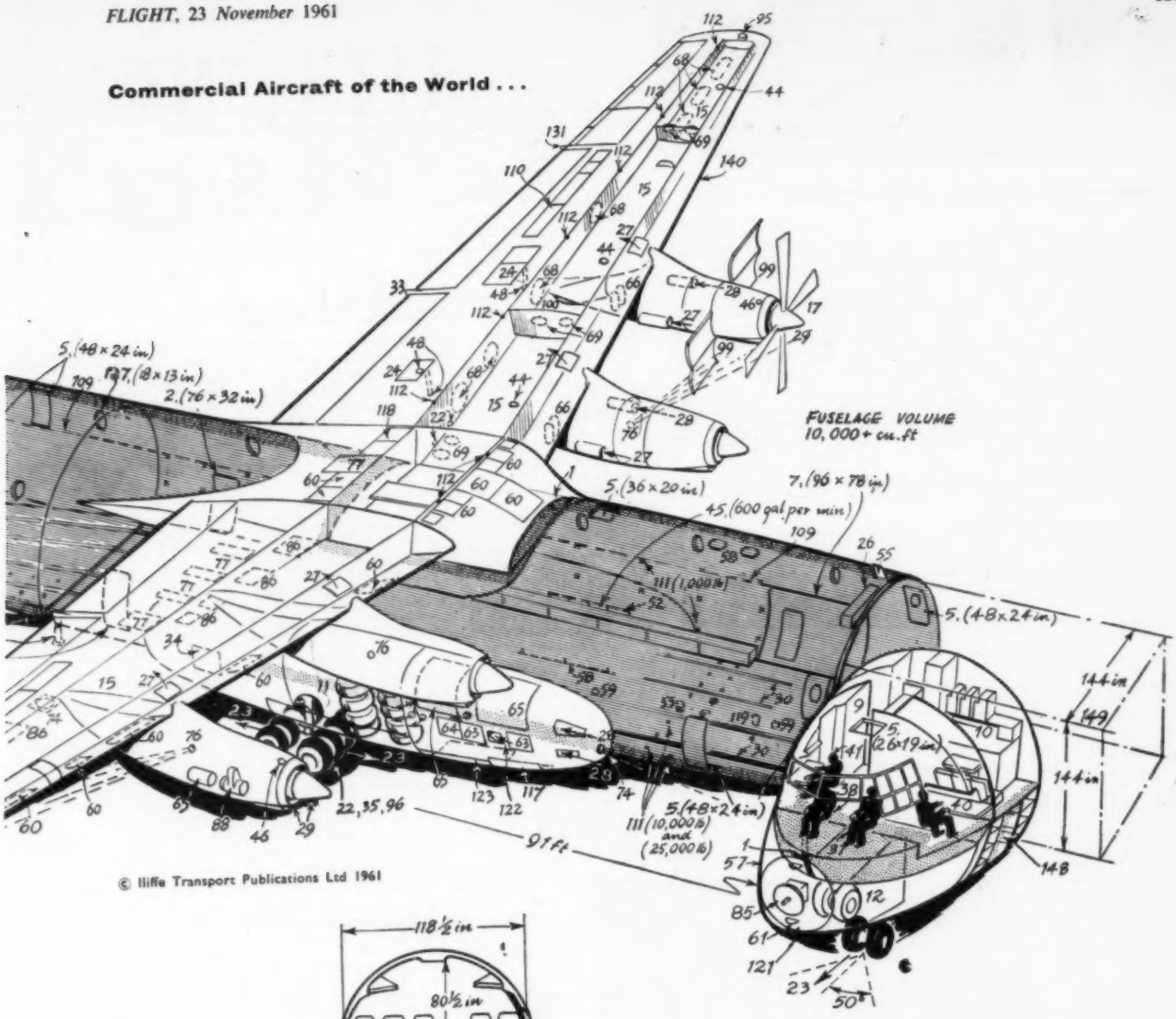


Above, SHORT SKYVAN 1 and BELFAST SC.5/31 *(text: pages 830-831)*
Right, SUD-AVIATION CARAVELLE 3 *(text: pages 831-833)*
"Flight" operators' reference drawings—see page 800 for key

United is the first US carrier to operate Caravelles

Commercial Aircraft of the World . . .



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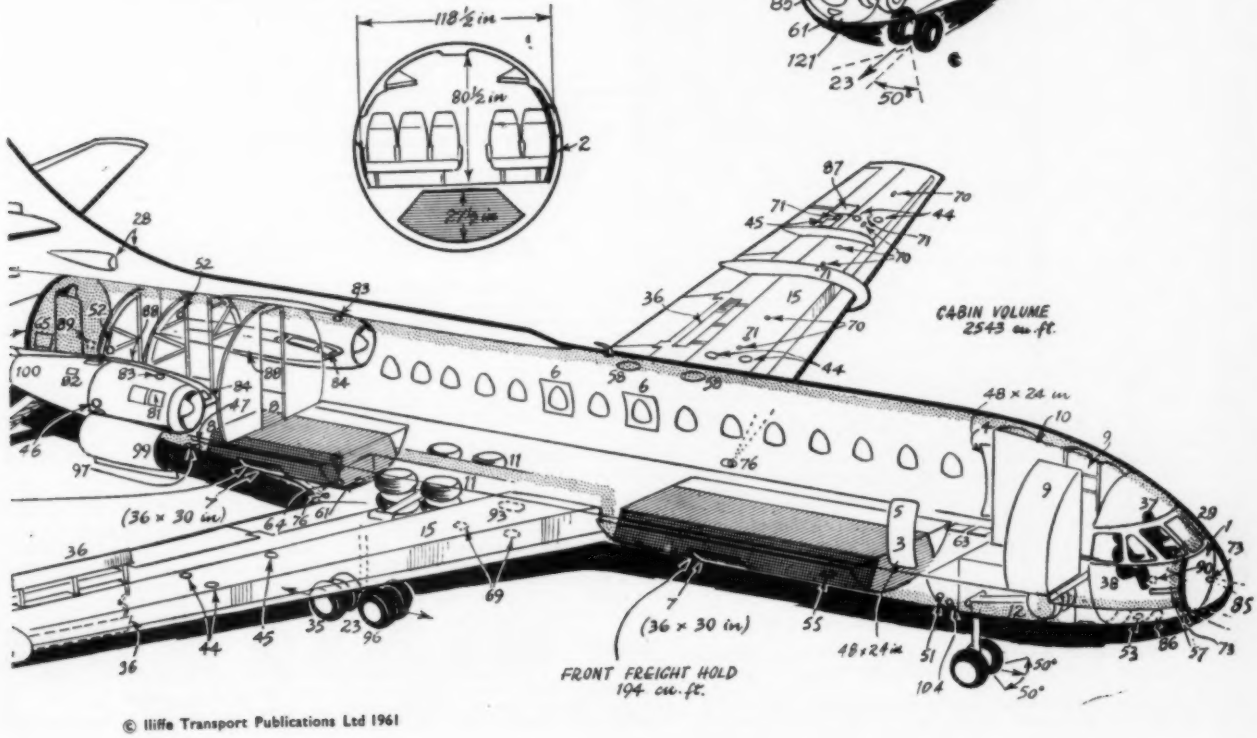

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Artist's impression of the Piaggio-Douglas PD-808 light jet transport

Commercial Aircraft of the World . . .

floor area (less flight deck), 169 sq ft; dimensions of largest door, 68in × 45in; max number of seats, 23 at 30in pitch.

Fuel capacity: 459 Imp gal.

Performance: Opt-cost (i.e., typical) cruising speed at 10,000ft and 21,380lb, 205kt; corres s.f.c., 0.68lb/hr/s.h.p.; take-off field length, max take-off weight, ISA, 3,900ft; landing field length, max landing weight, ISA, 3,715ft; range A (max payload), 300 n.m.; range B (max fuel), 1,050 n.m.; corres payload, 5,500 lb; VNE, 242kt IAS; VNO, 208kt IAS; VSO, at max landing weight, full flaps, 65kt IAS.

MH-262 Super Broussard This is the pressurized version of the MH-260, the prototype of which is said to be due to fly before the year's end. Last June it was expected that the first aircraft would fly in mid-1962 and be certificated and delivered in July 1963. Basic cost would be about £120,000.

MH-280 Super Broussard This is the designation of the MH-260 or MH-262 with Lycoming T53s of similar power to that of the Bastan.

MH-350 Broussard Major Resembling in appearance a scaled-down Super Broussard, this is a twin-engined "big brother" of the successful single-engined Broussard, of which some 400 have now been built. The first prototype is being built at Rheims and is due to fly in March 1962.

Powerplant: Two Continental GIO-470A piston engines of 310 h.p. each.

Dimensions: Span, 50ft; length, 35ft; wing area, 301 sq ft.

Weights: Max take-off (freight version), 6,950lb; weight empty, 4,380lb; capacity payload, 2,000lb.

Performance: Max cruising speed, 159 m.p.h.; take-off distance, max weight, to 50ft, 1,530ft; landing distance, over 50ft, 985ft; range A (max payload, with allowances), 100 n.m.; range B (max fuel, with allowances), 350 n.m.; corres payload, 1,500lb.

NAMC *Nihon Aeroplane Manufacturing Co Ltd, Daido Building, No 46, 1-chome, Minami-Sakumacho, Shiba, Minato-ku, Tokyo, Japan.*

YS-11 The manufacture of the YS-11 turboprop airliner was first proposed by the Japanese Ministry of International Trade and Industry in 1956. The major aircraft manufacturers set to work on project studies, and in the following year, with a government subsidy, the six largest aircraft manufacturing companies combined forces to launch the basic design work. These six companies were: Mitsubishi Heavy Industries, Reorganized Ltd; Kawasaki Aircraft Co Ltd; Fuji Heavy Industries Ltd; Shin Meiwa Industry Co Ltd; Japan Aircraft Manufacturing Co Ltd; and Showa Aircraft Industry Co Ltd.

In May 1957 these companies formed the Transport Aircraft Development Association, with the object of co-ordinating their efforts in design work, preparation of specifications, wind tunnel tests and construction of a full-size mockup. In June 1959, the Nihon Aeroplane Manufacturing Co was established under the Aircraft Industries Promotion Law with capital jointly provided by the Government and the private companies concerned to succeed the Transport Aircraft Development Association and to be responsible for the production and sales of the YS-11. The board of directors is composed of representatives of the Government and of the "big three"—Mitsubishi, Fuji and Kawasaki.

The paid up capital of the company was 3,750 million yen (about £3.75m) in October 1961, of which 2,050 million yen (£2.05m) was subscribed by the Government and 1,700 million yen (£1.7m) by the private companies. The capital is to be raised to reach a total of 4,700 million yen (£4.7m) in 1962. Production of the YS-11 is carried out with the close co-operation of the six companies, as follows:—

NAMC are responsible for design, production, quality control and sale of the YS-11. Others concerned are: *Mitsubishi*, fuselage and final assembly; *Kawasaki*, wings and engine nacelles; *Fuji*, tail unit; *Shin Meiwa*, rear fuselage; *Japan Aircraft*, ailerons and flaps; *Showa Aircraft*, honeycomb structural components.

The aircraft is powered by the most-developed Rolls-Royce Dart (RDa.10/1) engines, and the fuselage accommodates 52-60 passengers. The company estimate a demand for more than 150 aircraft between 1963-70 for domestic routes and export. The Japan Self-Defence Agency included 10 YS-11Ms (military version of the YS-11) in its five-year defence programme commencing fiscal year 1962, and All Nippon Airways announced their intention to purchase more than 25 YS-11s. Japan Maritime Safety Agency may also have two YS-11s for search and rescue.

The first prototype YS-11 is due to fly in the middle of March 1962, and the first production aircraft is scheduled to go into operation on Japanese domestic routes during the second half of 1963.

Basic price: 360 million yen (£360,000) approximately, excluding radio, autopilot, radar, etc.

Powerplant: Two Rolls-Royce Dart RDa.10/1 Mk 542 turboprops of 3,060 e.h.p. driving Dowty Rotol 14ft 6in propellers.

Dimensions: Span, 105ft; length, 86ft 3in; height empty, 30ft; wing area, 1,020 sq ft.

Weights: Max take-off, 50,265lb; max landing, 48,047lb; zero fuel, 44,092lb; capacity payload, 12,130lb; weight less fuel and payload, 31,988lb.

Payload accommodation: Cabin volume, 2,125 cu ft; baggage and freight volume, 390 cu ft; cabin length, 44ft 1in; max internal width, 8ft 10in; max height, 6ft 6 in; max usable floor area, 340 sq ft; dimensions of largest doors, 33in by 66in; max seats, 60 at 34in pitch.

Fuel capacity: 1,560 Imp gal (1,870 US gal).

Water-methanol capacity: 106 Imp gal (127 US gal).

Performance: Opt-cost (i.e., typical) cruising speed at 20,000ft and 48,047lb, 257kt; corres s.f.c., 0.633lb/s.h.p./hr; take-off field length, ISA, SL, max take-off weight, 2,890ft; landing field length, SL, 3,790ft; range A (max payload), 710 n.m.; range B (max fuel), 1,680 n.m.; corres payload, 5,400lb; VNE, 275kt EAS below 13,000ft, 245kt EAS below 13,000ft; VSO 72kt EAS.

Operators' drawing of YS-11: page 823

NORD AVIATION *Société Nationale de Constructions Aéronautiques du Nord, 12 bis Avenue Bosquet, Paris 7e, France.*

Nord 2502 Noratlas The Nord 2502 is a development of the Nord 2500 transport designed for the French Air Force, which was the basis for a series of variations. The prototype 2500, the 2501 powered by two Bristol Siddeley Hercules 758s of 2,040 b.h.p. each, first flew on September 10, 1949. By 1951 a civil 45-seater (or cargo) version of the 2501 had also been designed and orders placed by UAT and by an operator in Israel.

The 2502 differs from its predecessor in that it is equipped with two Turboméca Maborés in wing-tip nacelles to improve take-off performance. UAT, who operate six 2052s, introduced the type into service on their African routes in 1954. Other operators are Arkia (two) and Air Algérie (two).

Other developments, not in quantity production, are: **Nord 2503** (Pratt & Whitney R-2800-CB17s); **Nord 2506** (as 2502 but with air-brakes, re-designed flaps and landing gear adjustable for height, now cancelled) and **Nord 2508** (as 2501 but with Pratt & Whitney R-2800-CB17s of 2,500 h.p. and two-stage supercharging).

Powerplant: Two Bristol Siddeley Hercules 758/759 of 2,040 b.h.p. each, built under licence by SNECMA, driving Rotol R.108 propellers. (Optional: two 880lb. Turboméca Maboré turbojets.)

Dimensions: Span, 110ft 3in; length, 72ft 0½in; height, empty, 19ft 10½in; wing area, 1,089 sq ft.

Weights: Max take-off, 50,700lb; max landing, 48,500lb; zero fuel, 46,720lb; capacity payload, 16,640lb; weight less fuel and payload, 30,080lb.

Payload accommodation: Cabin, baggage or freight volume, 1,800 cu ft; cabin length, 32ft 4½in; max width, 9ft; max height, 6ft 7in; max usable floor area, 233.6 sq ft; dimensions of largest door, 7ft 2½in; max number of seats, 45.

Fuel capacity: 1,120 Imp gal (1,345 US gal).

Performance: Cont cruising speed, 170kt (195 m.p.h.) at 9,840ft and 50,000lb; corres fuel consumption, 0.244 st.m./lb; balanced field length, sea level, ISA, 2,085ft; at sea level, ISA + 15°C, 2,340ft; at 5,000ft, ISA, 2,565ft; landing distance from 50ft, 2,625ft; range A (max payload), 686 n.m. (790 st.m.); range B (max fuel), 1,480 n.m. (1,710 st.m.) corres payload, 12,710lb; corres cruise speed, 161kt (186 m.p.h.).

Transall C.160 Planned as a first co-operative venture between the French and German industries (although Nord 2501s have been built in Germany in quantity) is the Rolls-Royce Tyne-powered C.160. Primarily a military freighter for NATO, the C.160 is also offered for commercial use. Participants, grouped under the name Transall, are Nord Aviation for France, and Hamburger Flugzeugbau, Weser Flugzeugbau and Blume-Leichtbau und Flugtechnik for Germany. The project is a freighter with rear ramp-loading and an undercarriage retracting into twin pods on the fuselage. Agreement was reached in March 1960 to build three prototypes plus two further airframes for static and fatigue testing. The first three prototypes will be built by Nord in France and first flight was originally scheduled for July 1962. The second and third aircraft should fly respectively six and eight months later. Basic price is stated to be about £650,000.

Powerplant: Two Rolls-Royce Tyne RTy.20 turboprops of 6,100 e.h.p. driving de Havilland 18ft propellers, and two RB.153 booster jets.

Dimensions: 131ft 3in; length, 103ft 6in; height empty, 36ft 7in; wing area, 1,722.23 sq ft.

Weights: Max take-off, 106,925lb; max landing, 100,970lb; zero fuel, 90,057lb; capacity payload, 33,069lb.

Payload accommodation: Cabin volume, 4,800 cu ft; cabin length, 42ft 8in; max internal width, 10ft 4in; max height, 9ft 9in; max usable floor area, 602.8 sq ft; dimensions of largest door, 70.8in × 78.7in; max seats, 80.

Performance: Opt-cost (i.e., typical) cruising speed, 275kt at 25,000ft; corres fuel consumption, 0.087 n.m./lb; take-off distance, 1,970ft; landing distance, 1,970ft; range B (max fuel), 2,430 n.m. with fuel allowances.

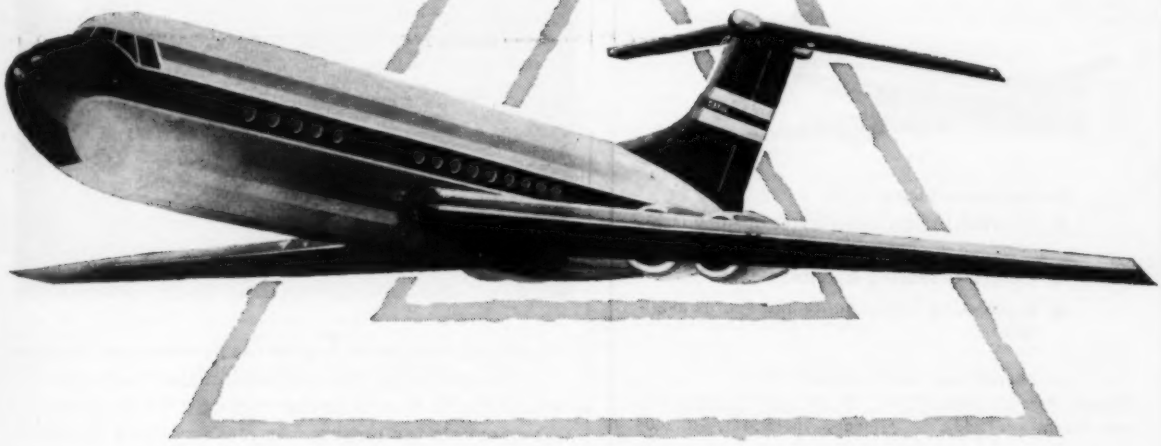
PEKING AERONAUTICAL INSTITUTE *Peking, Chinese People's Republic.*

Peking NR.1 First flown on September 4, 1958, the Peking NR.1 is believed to be the first aeroplane designed and built in Communist China. It appears to be similar in purpose to the Dove; it carries eight passengers on rather more power—two 520 h.p. piston engines. A general arrangement drawing appeared in *Flight* of April 24, 1959, page 587. Span is approximately 57ft 10in and length 42ft 7in. Cruising speed is given as 162kt (186 m.p.h.) and range as 665 n.m. (670 st.m.). Cruising height is quoted as 15,750ft.

PIAGGIO *Via Antonio Cecchi 6, Genova, Italy.*

Piaggio P.166 The first of three prototypes of the Piaggio P.166 flew on November 26, 1957, and production deliveries started at the end of April 1959. About 20 aeroplanes have now been delivered and 21 are to be supplied as executive VIP transports to the Aeronautica Militare.

FOR THE VICKERS VC.10....



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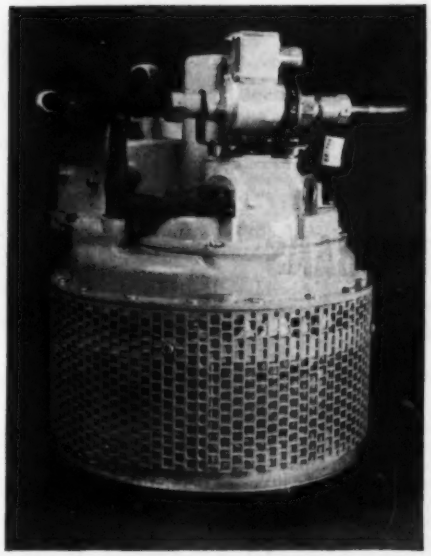
The discharge and safety valves used in this new system are basically identical, and both function automatically as inwards relief valves, if necessary. Similar valves have already been in service for some time in the 'Comet 4', and are also fitted in the 'Vanguard'. Emergency pressure controllers automatically assume control and maintain a safe cabin pressure in the remote event of malfunction of the primary control.



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Latest to operate the Twin Pioneer is Sierra Leone Airways

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Although designed as an executive aeroplane, the P.166 can be delivered in a number of versions, for cargo, ambulance, survey, etc. In the ten-seat high-density version, it is employed as a feederliner by several airlines, among which are: Ansett-Mandated Airlines (New Guinea), Papuan Air Transport (New Guinea), Deutsche Nah-Luftverkehr (Germany), Deutsche Taxiflug (Germany).

Powerplant: Two Lycoming GSO-480-BIC6 piston engines driving 7ft 9in Piaggio P1033-G4/BS or Hartzell HC-83 × 20-2CL/L9333 three-bladed propellers.

Dimensions: Span, 46ft 9in; length, 38ft 1in; height empty, 16ft 5in; wing area, 286 sq ft.

Weights: Max take-off, 8,115lb; max landing, 8,115lb; capacity payload, 1,830lb; weight less fuel and payload, 5,560lb.

Payload accommodation: Cabin volume, 300 cu ft; baggage and freight volume, 87 sq ft; cabin length, 11ft 8in; max internal width, 5ft 2in; max height, 5ft 9in; max usable floor area, about 60 sq ft; dimensions of largest door, 53in × 26in plus 41in × 11in optional; seats, 6-8.

Fuel capacity: 185 Imp gal (222 US gal).

Performance: Typical cruise speed, 163kt (188 m.p.h.) at 10,000ft and 8,115lb; corres fuel consumption, 29 Imp gal/hr; range A (max payload), 562 n.m. (647 st.m.); range B (max fuel), 1,040 n.m. (1,200 st.m.); V_{NE}, 192kt IAS; V_{NO}, 152kt IAS; V_{SO}, 64.5kt EAS.

Piaggio Douglas PD-808 Announced on April 21, 1961, this light jet 6/10-seat transport is a Douglas design which will be developed and built by Piaggio in Italy. PD-808 is the commercial business-executive version of the project, which is intended initially to meet Italian Air Force requirements. The arrangement between the two companies provides that Douglas will sell and service the PD-808 throughout most of the world, and may eventually manufacture the aircraft in the US under certain customer and production-rate conditions. Two aircraft are being built, the first being scheduled to fly late in 1962. Delivery is offered in 1963.

Powerplant: Two GE CJ610-1 turbojets of 2,850lb static take-off thrust at SL; or alternatively two Bristol Siddeley Viper 20 turbojets of 3,000lb static take-off thrust at SL.

Dimensions: Span, 40ft 8in (with tip-tanks); area, 225 sq ft; length, 39ft 6in.

Weights: Max take-off, 15,000lb; max landing, 14,300lb; capacity payload, 2,000lb; weight empty, 7,527lb.

Fuel capacity: 835 US gal, including tip-tanks of 112.5 US gal each.

Performance: (G.E. engines) Max cruising speed, 40,000ft, 520 m.p.h.; max flight duration, four hours; take-off FAA field length, 3,900ft; take-off over 50ft obstacle, 2,770ft; landing over 50ft, 2,350ft; approach speed, 119 m.p.h.

POLAND *Warsaw Aircraft Design Centre, Warszawski Osrodek Konstrukiji Lotniczych, WSK-Okecie, Poland.*

MD-12 Evolved from the earlier and smaller CSS-12 twin-engined aircraft to a Polskie Linie Lotnicze (LOT) specification, this Polish light transport was first shown publicly on September 6, 1959. The design of Prof Dr Francisyek Misztal and Prof Lesyek Duleba, the MD-12 is intended for use mainly as a passenger/cargo or all-cargo transport on short-haul domestic routes. Other versions cover ambulance, agricultural and survey duties, for which the short-field characteristics of the MD-12 are said to be suitable. The low wing has slotted ailerons.

Powerplant: Four Narkiewicz WN-3 air-cooled radial piston engines of 340 b.h.p. each.

Dimensions: Span, 69ft 11in; length, 51ft 10in; height, 19ft; wing area, 592 sq ft.

Weights: Max take-off, 16,530lb; payload, 4,188lb, weight less fuel and payload, 10,912lb.

Payload accommodation: Storage for 550lb baggage; max seats, 20.

Fuel capacity: 209 Imp gal (250 US gal).

Performance: Cruise speed, 154kt (177 m.p.h.) at 8,200ft; take-off to 50ft with engine cut on take-off, 2,625ft; full-payload range (including 30min reserve fuel), 378 n.m. (435 st.m.).

POTEZ *Etablissements Henry Potez, 46 Avenue Kléber, Paris XVI, France.*

Potez 840 First flown on April 25, 1961, the Potez 840 is a four-engined executive transport and feederliner. A production batch of 25 has been laid down by Potez, who are financing the project, and a firm order for 25 is said to have been placed by Turbo Flight Inc, a US business corporation. A second 840 is due to fly in the near future. Delivery to a commercial operator can be made early in 1963, and price of a production aircraft is quoted as "less than $400,000" (£150,000).

The reasons given by Potez for the choice of four Astazous instead of two Bastans are: superior performance in the engine-out case; passenger preference; ease of ferrying back to base, following an engine failure; superior reverse-thrust performance for landing (quoted as 800ft); and, with the use of 60° of flap, maximum exploitation of slipstream effect. Potez are putting special emphasis on their ability to support the 840 with a comprehensive after-sales service.

Potez 840

Powerplant: Four Turboméca Astazou II of 523 s.h.p. each driving Ratier Figeac 7ft propellers.

Dimensions: Span, 63ft 8in; length, 52ft; height empty, 17ft 8in; wing area, 377sq ft.

Weights: Max take-off, 18,700lb; max landing, 17,800lb; zero fuel, 16,000lb; capacity payload, 4,764lb.

Payload accommodation: Cabin volume, 670 cu ft; baggage and freight volume, 82 cu ft; cabin length, 22ft 10 in; max internal width, 6ft; max height, 5 ft 9in; max usable floor area, 91 sq ft; dimensions of largest door, 25in × 54in; max seats, 24; at 33in pitch, 16.

Fuel capacity: 446 US gal.

Performance: Opt-cost (i.e., typical) cruising speed, 280kt at 20,000ft and 17,800lb; corres fuel consumption, 2.45 n.m./gal; take-off field length (SR 422 B), 3,280ft; landing field length, 3,730ft; range A (max payload), 970 n.m.; range B (max fuel), 1,000 n.m.; corres payload, 3,160lb; cruise Mach number, 0.61; V_{NE}, 300kt IAS; V_{NO}, 270kt IAS; V_{SO}, 77kt IAS.

Potez 840 Executive

Powerplant: As above.

Dimensions: As above.

Weights: Max take-off, 19,600lb; max landing, 17,800lb; zero fuel, 13,700lb; max capacity payload, 4,000lb; weight less fuel and payload, 11,360lb.

Payload accommodation: As above, except: max seats, 10.

Fuel capacity: 872 US gal.

Performance: Opt-cost (i.e., typical) cruising speed, 278kt at 20,000ft and 16,500lb; corres fuel consumption, 2.45 n.m./gal; take-off field length (SR 422 B), 3,780ft; landing field length, 3,260ft; range A (max payload), 1,000 n.m.; range B (max fuel), 2,140 n.m.; corres payload, 2,000lb; placard speeds, as above.

SAAB *Svenska Aeroplan Aktiebolaget, Linkoping, Sweden.*

Scandia A-2 Although the Scandia first flew 15 years ago—on November 16, 1946—15 of the total of 18 that were built are still in service (with VASP). The aircraft was designed to meet the then-current ICAO and CAA requirements for passenger transport aircraft and was intended for short and medium stages. The first order was placed by SAS in 1948 and the Scandia was introduced into service in 1950.

Powerplant: Two Pratt & Whitney R-2180-E1 Twin Wasps of 1,650 b.h.p. driving 12ft 3in Hamilton Standard Hydromatic propellers.

Data appeared in *Flight* for November 20, 1959, page 614.

Saab 105 Designed primarily as a military and civil trainer and liaison aircraft, this twin-jet project, shown in model form at the Paris Salon in May, could also be used in an executive role. A prototype is being built at Linköping, target date for the first flight being early 1963. At present the project is being financed entirely by Saab, although strong Government interest is said to have been expressed. As an executive aircraft, the 105 seats four or five passengers, while for airline pilot training there is side-by-side seating, and two or three pupils can be accommodated in the rear of the cabin for navigational training. *Flight* reference: June 1, 1961.

Powerplant: Two Turboméca ducted fans of 1,540lb static thrust each.

Dimensions: Span, 31ft 2in; length, 34ft 5in; height, 8ft 10in; wing area, 175 sq ft.

Weights (executive version): Max take-off, 7,896lb; equipped weight, 4,540lb; manufacturer's weight empty, 4,440lb; max landing, 7,733lb.

Performance: Max continuous cruising speed, 450 m.p.h.; balanced field length, 2,890ft; landing distance from 50ft, 3,180ft; range at normal cruising speed, 1,450 st.m.

SCOTTISH AVIATION *Prestwick Airport, Ayrshire, Scotland.*

Twin Pioneer A 16-seat feederliner with true STOL capability, the Twin Pioneer is specifically intended for operations in remote areas of the world where available runway lengths are strictly limited. The prototype flew on June 25, 1955, and the first production aircraft followed rather less than a year later, on April 28, 1956. The latest version is the Series 3, in which 625 h.p. Alvis Leonides engines replace the 550 h.p. Leonides of the earlier series. Most operators are converting their Twin Pioneers to Series 3 standard.

Five Twin Pioneers have been modified by Scottish at the request of Philippine Air Lines, and supplied with Pratt & Whitney R-1340 Wasps; little structural change was required. Another specialized variant of the Twin Pioneer supplied to the Rio Tinto Finance & Exploration Co has a 9ft increase in wingspan with the installation of pods on the wing tips carrying electro-magnetic equipment for geographical survey. Some 25 Twin Pioneers have now been manufactured for civil use and airline operators include de Kroonduif (3), Philippine Air Lines (5), Borneo Airways (3), Sierra Leone Airways (2). *Flight* descriptions: July 1, 1960 (air test); September 4, 1959; November 1, 1957; July 6, 1956; and September 30, 1955. Basic price £66,500 less radio.

Twin Pioneer Series 3

Powerplant: Two Alvis Leonides 531/8B piston engines of 625 b.h.p. driving de Havilland propellers.

Dimensions: Span, 76ft 6in; length, 45ft 3in; height, 12ft 1in; wing area, 670 sq ft.

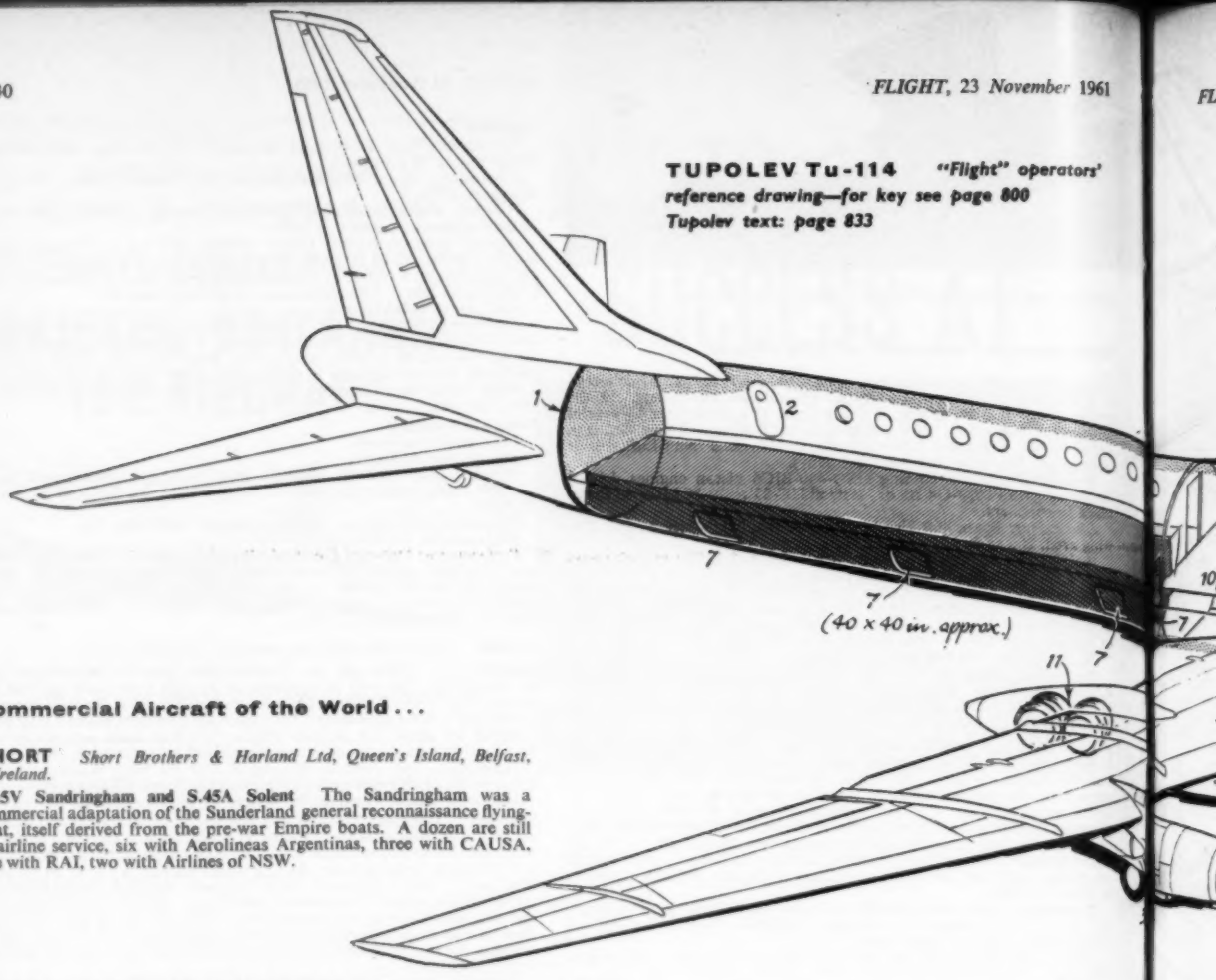
Weights: Max take-off, 14,600lb; max landing, 14,600lb; zero fuel, 14,600lb; capacity payload, 3,550lb; weight less fuel and payload, 10,200lb.

Payload accommodation: Cabin volume, 730 cu ft; baggage and freight volume, 99 cu ft; cabin length, 22ft 8in; max width, 6ft; max height, 5ft 9in; dimensions of largest door, 5ft 3in × 3ft 11in; max seats, 18.

Fuel capacity: 247 Imp gal (standard), 371 Imp gal (long range).

Performance: Cont cruise speed, 122kt (140 m.p.h.) at 8,000ft and 14,600lb; corres fuel consumption, 43 gal/hr; take-off field length, ISA, sea level, 1,150ft; ground run to unstick, 520ft; landing distance, ISA, sea level, 1,150ft; range A (max payload), 218 n.m. (250 st.m.); range B (max fuel), 684 n.m. (789 st.m.).

TUPOLEV Tu-114 *"Flight" operators' reference drawing—for key see page 800*
Tupolev text: page 833



Commercial Aircraft of the World . . .

SHORT *Short Brothers & Harland Ltd, Queen's Island, Belfast, N Ireland.*

S.25V Sandringham and S.45A Solent The Sandringham was a commercial adaptation of the Sunderland general reconnaissance flying-boat, itself derived from the pre-war Empire boats. A dozen are still in airline service, six with Aerolineas Argentinas, three with CAUSA, one with RAI, two with Airlines of NSW.

The Solent is also an airliner adaptation of a military flying-boat, in this case the Seaford G.R.1, which was originally known as the Sunderland IV. The Solent is powered by Bristol Siddeley Hercules 637V or 733 radials and has a higher gross weight. It has been used by BOAC, Aquila Airways, Trans-Oceanic Airways and TEAL. The last one in airline service was withdrawn by TEAL in September 1960.

Facts and figures in respect of the Sandringham appeared in *Flight*, November 20, 1959, page 614.

SC.7 Skyvan In June 1959 Shorts announced the formation of a Light Aircraft Division whose first project, a private venture, would be a general purpose transport with van-type loading. This was the SC.7, whose general conception is attributed to the Miles HDM 106 project, now defunct. In August 1960 Shorts named the project Skyvan and released more details. Two aircraft were to be built initially, the first being planned to make its maiden flight in the summer of 1961. This programme is proceeding but has been delayed by approximately one year because of pressure of work on other projects.

Simplicity with ruggedness is intended to be the main feature of the Skyvan. Though not claimed to be a true STOL, it will carry 1½ tons of payload in its 6½ft square fuselage from any half-mile field or strip. The Skyvan Mk 1's Continentals will probably be built under licence by Rolls-Royce when production warrants it, while the primarily military Astazou-powered Mk 2 has improved payload-range.

Flight references: May 8, 1959; September 11, 1959; August 26, 1960; September 2, 1960. *Operators' reference drawing: page 826.*

Skyvan 1

Powerplant: Two Rolls-Royce Continental GTSIO-520 piston engines of 390 h.p. each driving 8ft Hartzell propellers.

Dimensions: Span, 64ft 1in; length, 38ft 11in; height, 13ft 10in; wing area, 373 sq. ft.

Weights: Max take-off, 9,500lb; max landing, 9,500lb; zero fuel, 9,030lb; capacity payload, 3,000lb; weight less fuel, crew and payload, 6,030lb.

Payload accommodation: Cabin volume (less flight deck), 676 cu ft; cabin accommodational length, 16ft; max internal width, 6ft 6in; max height, 6ft 6in; max usable floor area (less flight deck), 104 sq ft; dimensions of largest door, 78in × 78in; max number of seats, 15 at 36in pitch.

Fuel capacity: 150 Imp gal.

Performance: Opt-cost (i.e., typical) cruising speed at 5,000ft and 9,300lb, 140kt; corres s.f.c., 4.5 n.m./Imp gal; take-off field length, to 50ft, ISA, SL, 9,500lb, 1,468ft; landing field length, from 50ft, ISA, SL, 9,000lb, 1,766ft; range A (max payload), 360 n.m.; range B (max fuel), 845 n.m.; corres payload, 2,350lb; V_{NE}, 193kt IAS; V_{NO}, 152kt IAS; V_{SO}, 56kt IAS.

Skyvan 2

Powerplant: Two Turboméca Astazou 2 turboprops of 550 e.h.p. each driving Ratier-Figeac three-bladed CS FF reversible propellers.

Dimensions: Same as Skyvan 1.

Weights: Max take-off, 11,500lb; max landing, 11,500lb; zero fuel, 10,690lb; capacity payload, 4,500lb; weight less fuel, crew and payload, 6,190lb.

Payload accommodation: Cabin volume (less flight deck), 676 cu ft; cabin accommodational length, 16ft; max internal width, 6ft 6in; max height, 6ft 6in; max usable floor area (less flight deck), 104 sq ft; dimensions of largest door, 78in × 78in; max number of seats, 15 at 36in pitch.

Fuel capacity: 175 Imp gal.

Performance: Opt-cost (i.e., typical) cruising speed at 10,000ft and 11,000lb, 160 kt; corres s.f.c., 3.4 n.m./Imp gal; take-off field length, to 50ft, ISA, SL, at 11,500lb, 1,365ft; landing field length, from 50ft, ISA, SL, at 11,000lb, 1,498ft; range A (max payload), 370 n.m.; range B (max fuel), 625 n.m.; corres payload, 3,900lb; V_{NE}, 205kt IAS; V_{NO}, 180kt IAS; V_{SO}, 61kt IAS.

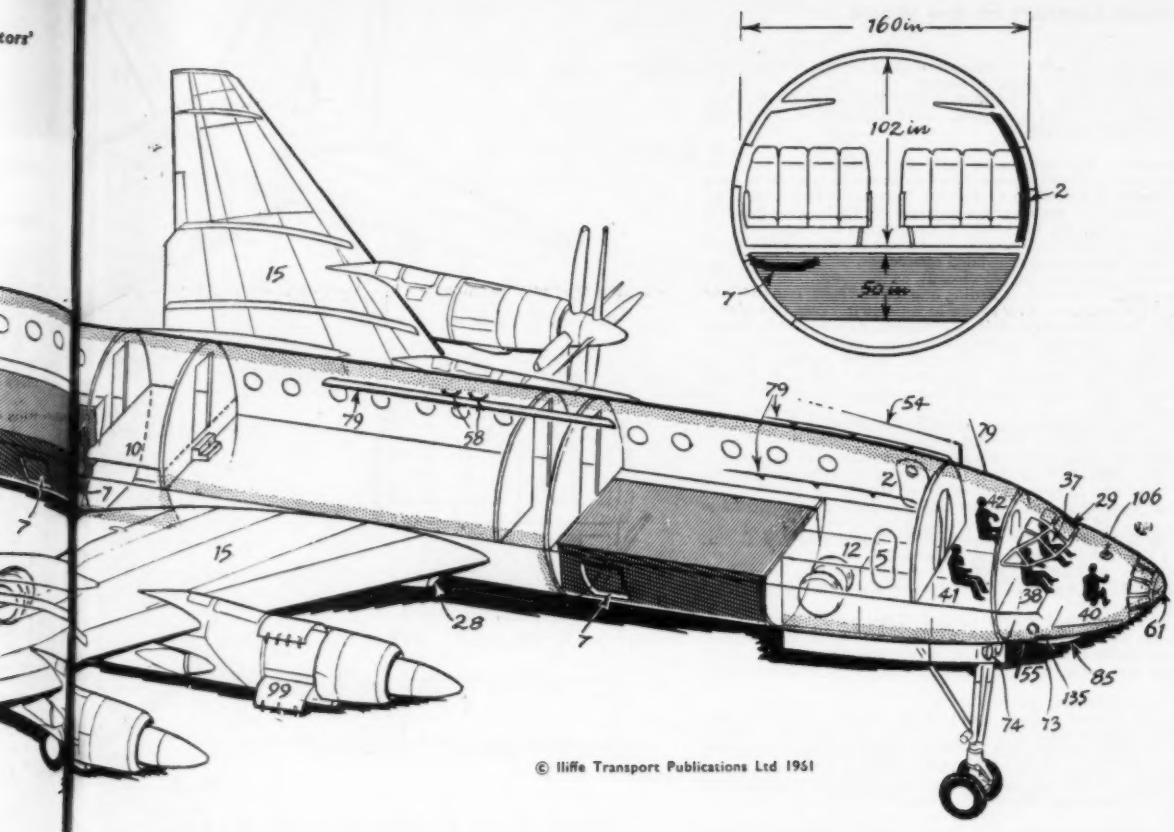
SC.5 Belfast Announced in February 1959, and known until December 1960 as the Britannic, Short's big freighter was designed to a requirement for an RAF Transport Command strategic transport. A contract for ten SC.5/10 Belfast C. Mk 1s was signed on December 21, 1960, and these are in production for Transport Command. The first should fly late in 1962, and these RAF aircraft will from the outset be equipped for blind landing.

The civil version, the SC.5/31, is offered for delivery in 1965 or 1966. It has a swing-nose hinging to starboard for loading and unloading in place of the rear doors of the SC.5/10, and both payload and maximum take-off weight are considerably increased. The double-deck SC.5/31 promises to have exceptional payload-range capabilities and very low operating costs. With 138 passengers on the top deck, with full amenities, and 55,000lb of palletized freight on the lower deck, a one-way passenger fare across the Atlantic of £30 would be possible. The SC.5/31 has been designed to carry payloads of 100,000lb nonstop between New York and London. Price would be between £1.6m and £1.7m, depending upon the equipment installed. A new terminal cargo-handling system has been designed by Short & Harland for the civil Belfast.

The SC.5/20 is a proposed tactical version of the military Belfast with an advanced Tyne (the Stage 5). An STOL version of the Belfast is also contemplated.

SC.5/31

Powerplant: Four Rolls-Royce RTy.31 of 7,490 e.h.p. driving 20ft de Havilland 4/9000/7 propellers.



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Dimensions: Span, 158ft 9in; length, 136ft 5in; height empty, 47ft; wing area, 2,466 sq ft; sweepback at quarter-chord, 7.05°.

Weights: Max take-off, 300,000lb; max landing, 250,000lb; zero fuel, 230,000lb; design capacity payload, 100,000lb; weight less fuel, crew and payload, 129,600lb.

Payload accommodation: Cabin volume, 6,100 cu ft on upper deck for passengers or freight, 5,400 cu ft on lower deck for freight; 900 cu ft for passengers' baggage; cabin accommodational length, 79ft; max internal width, 16ft 3in; max height, 13ft 5in; max usable floor area (less flight deck), 948 sq ft on upper deck for passengers, 840 sq ft on lower deck for freight; dimensions of largest door, 12ft × 12ft, the whole of the cross-section being available on opening the swing-nose; max number of seats (both decks), 255 at 32in pitch.

Fuel capacity: 12,000 Imp gal.

Water-methanol capacity: 320 Imp gal.

Performance: Opt-cost (i.e., typical) cruising speed at 17,500ft (SR) and 230,000lb, 341kt; at 27,500ft (LR) and 230,000lb, 316kt; corres s.f.c., 0.0435 n.m./lb (SR), 0.057 n.m./lb (LR); take-off field length, balanced field, max weight, ISA, SL, 9,600ft; landing field length, scheduled distance, max landing weight, ISA, SL, 5,400ft; range A (max payload), 3,200 n.m.; range B (max fuel), 5,000 n.m.; corres payload, 69,000lb; cruise Mach number, 0.635; VNE, 320kt IAS; VNO, 260kt IAS; VSO, 107kt IAS.

SIPA *Société Industrielle Pour l'Aéronautique, 178 Avenue de Neuilly, Neuilly-sur-Seine.*

Sipa Presence S-272 The Presence was first presented at the Paris Salon in May 1961. It is a twin-Astazou light transport freighter and executive project, to which market reaction is now being assessed. An unusual feature is the provision of a swing-nose.

Powerplant: Two Turboméca Astazou II turboprops of 562 e.h.p. each driving Ratier FH 76 7ft 2in propellers.

Dimensions: Span, 57ft 1in; length, 45ft 7in; height empty, 15ft 1in; wing area, 355 sq ft.

Weights: Max take-off, 10,736lb; max landing, 10,251lb; zero fuel, 8,091lb; capacity payload, 3,530lb; weight less fuel, crew and payload, 6,614lb (transport), 6,382lb (cargo).

Payload accommodation: Cabin volume (less flight deck), 635 cu ft; baggage and freight volume, 56 cu ft; cabin accommodational length, 21ft; max internal width, 7ft; max height, 5ft 6in; max usable floor area (less flight deck), 129 sq ft; dimensions of largest door, 51in × 53in; max number of seats, 12 (or 16 side-by-side) at 35in pitch.

Fuel capacity: 396 US gal.

Water-methanol capacity: 10.5 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 20,000ft and 10,736lb, 224kt; corres s.f.c., 0.537lb/h.p./hr; take-off field length, 1,755ft; landing field length, 1,720ft; range A (max payload), 162 n.m.; range B (max fuel), 1,350 n.m.; corres payload, 1,080lb; cruise Mach number, 0.36; VNO, 224kt IAS; VSO, 61.5kt IAS.

SUD-AVIATION *Société Nationale de Constructions Aéronautiques, 37 Boulevard de Montmorency, Paris.*

S.E.2010 Armagnac The biggest and heaviest piston-engined airliner to see regular service, the Armagnac first flew on April 2, 1949. Eight production aircraft were built in 1950-53, but none is now operational.

Powerplant: Four Pratt & Whitney R-4360-B13 of 3,500 b.h.p., driving Curtiss propellers. Data appeared in *Flight*, November 20, 1959, page 614.

S.O.30P Bretagne Derived from the S.O.30N (Gnôme Rhone N 48/49), which first flew on February 26, 1945, and from the S.O.30R Bellatrix (Gnôme Rhone 14.Rs), the Bretagne went into production to an Air France specification. Fifty were built up to 1954 and delivered to Aigle Azur, Air Algérie, Air Maroc, Cosara, and to the French Services. The Bretagne is now operated only by the latter for military and VIP transport. Two versions were built, the 30P-1 and the 30P-2 with 2,400 h.p. Pratt & Whitney R-2800-CA18s.

Powerplant: Two Pratt & Whitney R-2800-43 driving Curtiss Electric 13ft 5in propellers. Data appeared in *Flight* for November 20, 1959, page 615.

S.E.161 Languedoc A development of the Bloch 160 and of the Bloch 161, the Languedoc was put into production with Gnôme Rhones in 1945, the first flying on September 17 of that year. Some 55 were built

France's bid for supersonic supremacy: the Super Caravelle, in the development of which the British Aircraft Corporation may co-operate

Commercial Aircraft of the World . . .

for Air France and LOT. It was also operated by Aviaco, Misrair and Air Liban, but it is now no longer in service.

Powerplant: Four Pratt & Whitney R-1830-SC3Gs of 1,200 b.h.p. driving Hamilton 10ft 10in propellers. Data appeared in *Flight* for November 20, 1960, page 820.

S.E.210 Caravelle The decision to build the Caravelle was taken in January 1953 after a design competition: a French Government contract was awarded in July 1953 to Sud-Est Aviation (which combined with Ouest-Aviation to become Sud-Aviation in 1957), and the first Caravelle flew on May 27, 1955. Air France signed a contract for an initial order for 12 in February 1956. Following certification in April 1959, Air France inaugurated scheduled services on May 12, 1959.

The order book accounts for 146 aircraft, as follows:—

Air France, 35 (29 delivered, including one to **Air Liban**, one to **Tunis Air**); **SAS**, 23 (18 delivered, four leased to **Swissair**); **Varig**, two (delivered); **Finnair**, four (three delivered); **Air Algerie**, six (delivered); **Royal Air Maroc**, two (delivered); **Alitalia**, 14 (ten delivered); **Sabena**, eight (delivered); **General Electric**, one (delivered); **United Airlines**, 20 (ten delivered); **Iberia**, four; **Aerolineas Argentinas**, three; **TWA**, 20; **Panair do Brasil**, four. A further 43 aircraft are on option.

Caravelle 1 The first production deliveries are of this variant, which is powered by Avon 522s. Without structural modification, higher-powered Avons can be fitted, the designation then becoming Caravelle 3. All airlines who ordered Caravelle 1s have carried out this modification, excluding Varig, who have one Caravelle 1 in service.

Powerplant: Two Rolls-Royce Avon 522 (RA.29/1) of 10,500lb static thrust each.

Dimensions: Span, 112ft 6in; length, 105ft; height empty, 25ft 6in; wing area, 1,579 sq ft; sweepback at ¼ chord, 20°.

Weights: Max take-off, 95,900lb; landing, 91,338lb; zero fuel, 76,060lb; capacity payload, 18,300lb; weight less fuel and payload, 57,760lb.

Payload accommodation: Cabin volume, 2,800 cu ft; baggage and freight volume, 483 cu. ft; cabin length, 55ft; width, 9ft 10in; height, 6ft 10in; max usable floor area, 457 sq ft; dimensions of largest door, 65in × 36in; max seats, 80 (five abreast); seat pitch, 39in first class, 35in tourist.

Fuel capacity: 4,200 Imp gal (5,000 US).

Performance: Typical cruising speed, 397kt (456 m.p.h.) at 32,800ft and 80,900lb; balanced field length, max weight, sea level, ISA, 5,900ft; ISA + 15°C, 6,750ft; 5,000ft, ISA, 9,900ft; landing distance from 50ft, 5,315ft; range A (max payload), 1,390 n.m. (1,600 st.m.); range B (max fuel), 2,420 n.m. (2,790 st.m.); corres payload, 4,640lb; corres cruise speed, 398kt (458 m.p.h.); MNO, 0.75; VNO, 300kt EAS.

Caravelle 3 Powered by Avon 527s (RA.29/3) of 11,400lb static thrust, this 101,413lb version is the standard production aeroplane, to which Caravelle 1s can be converted. This version is operated by Air France, Air Algérie, SAS, Royal Air Maroc, Swissair, Alitalia, Air Liban, and Tunis Air. *Operators' reference drawing: pages 826-827*

Powerplant: Two Rolls-Royce Avon 527 (RA.29/3) of 11,400lb minimum guaranteed thrust.

Dimensions: Span, 112ft 6in; length, 105ft; height empty, 29ft 6in; wing area, 1,579 sq ft; sweepback at ¼ chord, 20°.

Weights: Max take-off, 101,413lb; max landing, 96,563lb; zero fuel, 78,264lb; capacity payload, 18,300lb; weight less fuel, crew and payload, 57,981lb; operating weight, empty, 59,083lb.

Payload accommodation: Cabin volume (less flight deck), 2,800 cu ft; baggage and freight volume, 534 cu ft; cabin accommodational length, 55ft; max internal width, 9ft 10in; max height, 6ft 7in; max usable floor area (less flight deck), 457 sq ft; dimensions of largest door, 65in × 36in; max number of seats, 80 at 36in pitch.

Fuel capacity: 4,890 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 32,808ft and 92,500lb, 412kt; corres s.f.c., 0.153 n.m./kg; take-off field length, ISA, SL, max take-off weight (SR 422 A), 6,000ft; landing field length, ISA, SL, max landing weight (SR 422 A), 5,900ft; range A (max payload), 1,650 n.m.; range B (max fuel), 2,380 n.m.; corres payload, 8,830lb; cruise Mach number, MNO, 0.77; VNE, 325kt IAS; VNO, 300kt IAS; VSO, 107kt IAS at 90,000lb.

Caravelle 6N This version has Avon 531 turbojets fitted with noise suppressors. Caravelle 3s can be converted to this standard if required. Sabena, Air Algérie and Alitalia operate or have Caravelle 6Ns on order.

Powerplant: Two Rolls-Royce Avon Mk 531 of 12,500lb minimum guaranteed thrust.

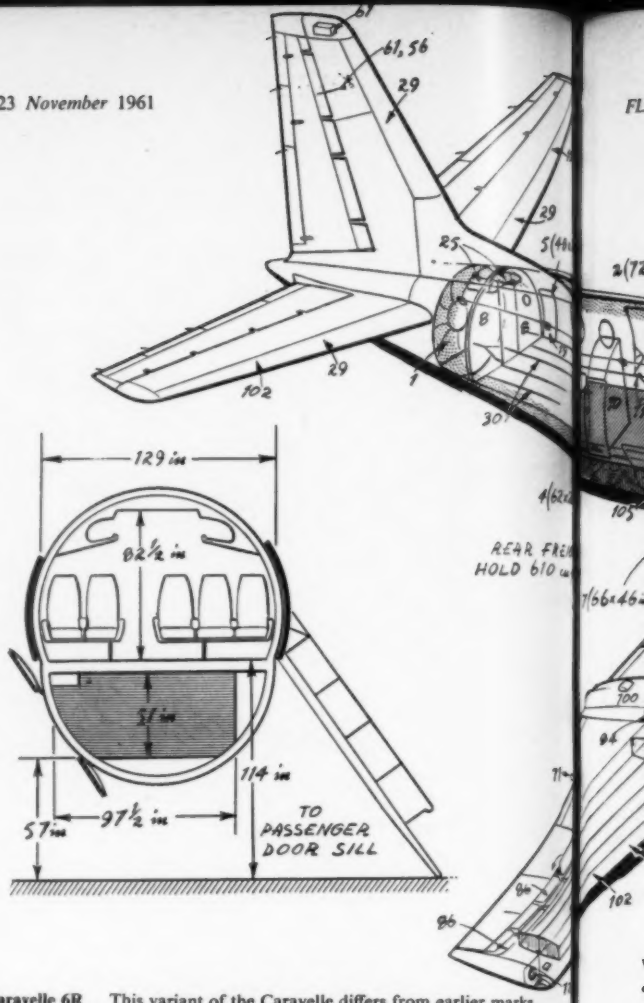
Dimensions: Span, 112ft 6in; length, 105ft; height empty, 29 ft 5in; wing area, 1,579 sq ft; sweepback at ¼ chord, 20°.

Weights: Max take-off, 105,822lb; max landing, 100,750lb; zero fuel, 78,264lb; capacity payload, 18,300lb; weight less fuel, crew and payload, 60,290lb.

Payload accommodation: Cabin volume (less flight deck), 2,800 cu ft; baggage and freight volume, 534 cu ft; cabin accommodational length, 55ft; max internal width, 9ft 10in; max height, 6ft 7in; max usable floor area (less flight deck), 457 sq ft; dimensions of largest door, 65in × 36in; max number of seats, 80 at 36in pitch.

Fuel capacity: 4,890 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 32,808ft and 94,800lb, 440kt; corres s.f.c., 0.149 n.m./kg; take-off field length, SR 422 B, SL, ISA, max take-off weight, 6,365ft; landing field length, SR 422 B, SL, ISA, max landing weight, 6,102ft; range A (max payload), 1,830 n.m.; range B (max fuel), 2,390 n.m.; corres payload, 11,034lb; cruise Mach number MNO 0.77; VNE, 350kt IAS; VNO, 325kt IAS; Vs, cruise configuration, landing gear and flaps up, 107kt IAS at 90,000lb.



Caravelle 6R This variant of the Caravelle differs from earlier marks both in respect of the powerplant—Avon 533s of 12,600lb thrust equipped with thrust reversers—and a new improved cockpit with larger windows. This version has been ordered by United Air Lines, Iberia, and Panair do Brasil.

Powerplant: Two Rolls-Royce Avon Mk 533R of 12,600lb minimum guaranteed thrust.

Dimensions: Span, 112ft 6in; length, 105ft; height empty, 29ft 6in; wing area, 1,579 sq ft; sweepback at ¼ chord, 20°.

Weights: Max take-off, 110,231lb; max landing, 105,000lb; zero fuel, 81,570lb; capacity payload, 18,300lb; weight less fuel, crew and payload, 62,082lb.

Payload accommodation: Cabin volume (less flight deck), 2,800 cu ft; baggage and freight volume, 473 cu ft; cabin accommodational length, 55ft; max internal width, 9ft 10in; max height, 6ft 7in; max usable floor area (less flight deck), 457 sq ft; dimensions of largest door, 65in × 36in; max number of seats, 80 at 36in pitch.

Fuel capacity: 4,890 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 32,808ft and 94,800lb, 440kt; corres s.f.c., 0.145 n.m./kg; take-off field length, SR 422 B, SL, ISA, max take-off weight, 6,650ft; landing field length, SR 422 B, SL, ISA, max landing weight, 5,670ft; range A (max payload), 1,890 n.m.; range B (max fuel), 2,200 n.m.; corres payload, 13,826lb; cruise Mach number MNO, 0.77; VNE, 350kt IAS; VNO, 325kt IAS; Vs, cruise configuration, landing gear and flaps up, 107kt IAS at 90,000lb.

Caravelle 7 This was the version powered by GE CJ805 turbofans, for possible US production. It has now been replaced by the Caravelle 10A.

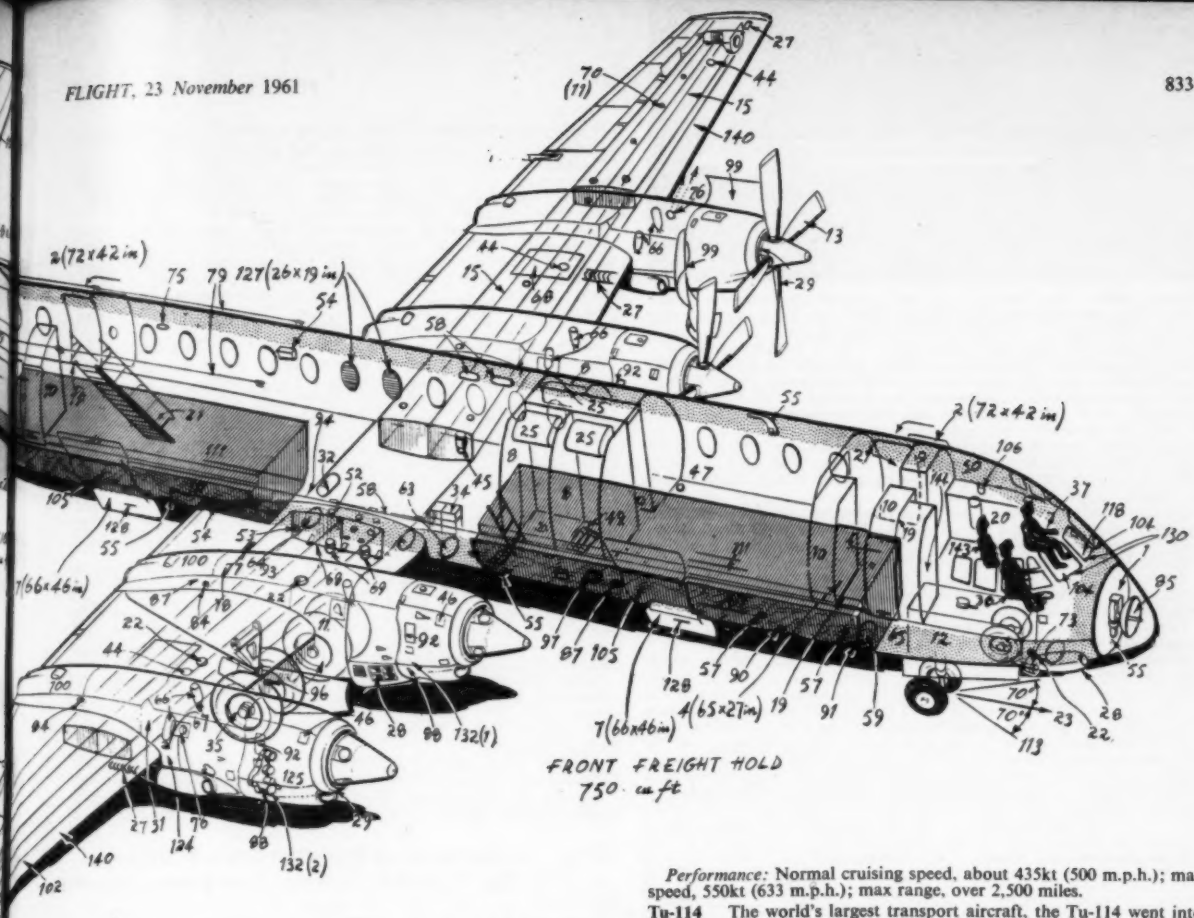
Caravelle 10A This is the US-engined version ordered by TWA, described as "la Nouvelle Caravelle," powered by GE CJ805-23C turbofans. The fuselage is one metre longer than previous versions; other modifications include improved cockpit visibility, location of cabin windows, installation of freight compartment, etc.

Planned for the Caravelle 10A are a leading-edge glove to increase sweep and to reduce thickness/chord ratio, raising max permitted Mach number from 0.77 to 0.81. There would also be a speed fairing at the junction of the tailplane and fin, and double-slotted flaps to improve airfield performance.

The following developments of the Caravelle 10A have been unofficially reported: **10B**, with Pratt & Whitney JT8Ds; **10BF**, (F for Fast) with 1,000lb additional fuel; **10C**, a high-density (99-seat) version with Avon 533s; **10D**, powered by Rolls-Royce RB.174 engines.

Powerplant: Two General Electric CJ805-23C turbofans of 16,100lb minimum guaranteed thrust.

Dimensions: Span, 112ft 6in; length, 108ft 4in; height empty, 29ft 6in; wing area, 1,579 sq ft; sweepback at ¼ chord, 20°.



VICKERS-ARMSTRONGS VANGUARD

"Flight" operators' reference drawing—for key see page 800

Weights: Max take-off, 114,640lb; max landing, 109,128lb; zero fuel, 87,082lb; capacity payload, 19,195lb; weight less fuel, crew and payload, 66,963lb.

Payload accommodation: Cabin volume (less flight deck), 2,970 cu ft; baggage and freight volume, 469 cu ft; cabin accommodational length, 58ft 4in; max internal width, 9ft 10in; max height, 6ft 7in; max usable floor area (less flight deck), 490 sq ft; dimensions of largest door, 65in × 36in; max number of seats, 89 at 36in pitch.

Fuel capacity: 4,890 US gal.

Performance: Opt-cost (i.e., typical) cruising speed at 30,000ft and 99,000lb, 457kt; corres s.f.c., 0.130 n.m./kg; take-off field length, SR 422 B, SL, ISA, max take-off weight, 6,250ft; landing field length, SR 422 B, SL, ISA, max landing weight, 5,170ft; range A (max payload), 1,990 n.m.; range B (max fuel), 2,440 n.m.; corres payload, 13,673lb; cruise Mach number, MNO, 0.81; VNE, 350kt IAS; VNO, 330kt IAS; Vs, cruise configuration, landing gear and flaps up, 107kt IAS at 90,000lb.

Caravelle 15 This is believed to be the designation of the Baby Caravelle, a project for a smaller-capacity version of the Caravelle intended for short-haul operations. No official information has been published.

Super Caravelle Announced in France in April 1960 were plans for a M2.2, 2,500-mile range supersonic transport to be built jointly by Sud-Aviation and Marcel Dassault. A model was exhibited at the Paris Salon in May 1961. Engines could be four Bristol Siddeley Olympus and collaboration by the British Aircraft Corporation is probable.

TRANSALL See under Nord.

TUPOLEV

Tu-104 First flown in 1955 (reportedly on June 17 of that year), the Soviet Union's first jet transport made its international début in March 1956. Since then it has been built in considerable numbers—certainly some hundreds—and it is Aeroflot's staple equipment for domestic and international express trunk-route services.

The aircraft has been exported, in the Tu-104A version, to Czechoslovakia's airline CSA, who operate four. Variants are as follows:—Tu-104: original "prestige" aircraft, seating 50; Tu-104A: 70-seater; Tu-104B: version with longer fuselage seating up to 100 in five-abreast seats; Tu-104E: a development with improved engine.

Basic price: reported as 8 million roubles.

Powerplant: Two Mikulin AM-3 turbojets of about 19,000lb thrust.

Dimensions (Tu-104A and B): Span, 113ft 4in; length (Tu-104A), 127ft 5 in; length (Tu-104B), about 131ft.

Weights: Max take-off, 160,000-165,000lb.

Payload accommodation (Tu-104B): First cabin seats 30; second, 15; third, 55. Luggage and cargo compartments are 424 cu ft greater in capacity than those of Tu-104A.

Performance: Normal cruising speed, about 435kt (500 m.p.h.); max speed, 550kt (633 m.p.h.); max range, over 2,500 miles.

Tu-114 The world's largest transport aircraft, the Tu-114 went into regular service with Aeroflot on April 24, 1961, on the Moscow-Khabarovsk route. Last June ten were in service, and more were due to be delivered each year. Some remarkable world records have been homologated by the FAI. Over a closed circuit of 1,000km and carrying a load of 25 metric tons a speed of 871.38km/hr (541 m.p.h.) was averaged; over 2,000km a load of 25 metric tons was carried at a speed of 857.277km/hr (532 m.p.h.).

Powerplant: Four TB-12 turboprops of 12,000 s.h.p. Eight four-blade contra-rotating propellers of over 18ft diameter, with electric synchronizing and pneumatic emergency feathering.

Dimensions: Span, 177ft 2in; length, 154ft 10in; height, 38ft 8in; wing area, 3,014 sq ft.

Weights: Max take-off, probably in excess of 410,000lb.

Payload accommodation: Passenger capacity, 120-220.

Tu-114D This is a more or less direct conversion of the "Bear" bomber. Mr Tupolev has stated that this type is intended to transport quite a small number of passengers with baggage, mail and other urgent freight over very long distances.

Tu-124 While Great Britain and America are still in the project stage with turbofan short-range airliners, Russian has had a prototype of the Tu-124, meeting generally similar specifications, flying for more than a year. The standard version has only 44 seats—22 of first-class standard and 22 of a removable variety, apparently less comfortable. One report states that accommodation for up to 68 economy-class passengers is possible. Cruising speed is said to be 500-530 m.p.h. and maximum speed 620 m.p.h.

VICKERS *Vickers-Armstrongs (Aircraft) Ltd, Weybridge, Surrey, England. Member of the British Aircraft Corporation.*

Viking Designed as a replacement for the Douglas DC-3, the unpressurized VC1 Viking first flew on June 22, 1945. Three main versions of this 21-27 passenger airliner were produced: the Viking 1A with wings and tailplane of fabric-covered geodetic, the Viking 1 with wings and tailplane of conventional metal construction and—the most numerous variant—the Viking 1B, which featured a 28in longer forward fuselage. A total of 166 Vikings were built, BEA being the first operator. A total of 60 Vikings are owned by about 20 operators, mostly British independents. Asking price for a good Viking is now about £12,000.

Powerplant: Two Bristol Siddeley Hercules 634 of 1,675 b.h.p. driving 13ft 3in de Havilland or Rotol four-bladed propellers.

Dimensions: Span, 89ft 3in; length, 62ft 10in; height, 196ft 6in; wing area, 882 sq ft.

Weights: Max take-off, 34,000lb; landing, 33,250lb; capacity payload, 7,120lb; weight less fuel and payload, 24,000lb.

Payload accommodation: Cabin volume, 1,665 cu ft; baggage and freight volume, 250 cu ft; cabin length, 39ft 3in; max width 7ft 11in; max height, 6ft 8in; usable floor area, 249 sq ft; max seats, 27.

Fuel capacity: 750 Imp gal (5,400lb).

Performance: Cont cruising speed, 182kt (209 m.p.h.) at 10,000ft and 32,500lb, with fuel consumption of 88 Imp gal/hr; balanced field length, sea level, ISA, 3,600ft; landing distance from 50ft (unfactored),

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3,650ft. Range A (max payload), 1,000 n.m. (1,150 st.m.); range B (max fuel), 1,946 n.m. (2,242 st.m.) at 149kt (171 m.p.h.) at 10,000ft with 4,600lb payload.

Viking 3 A modification by Cunard Eagle primarily to the cooling system of the Hercules 634, enables Viking 1, 1A, 1B and 2 payload to be increased by 1,200 to 1,400lb where it is limited by WAT curves. Cunard Eagle designate modified aircraft **Viking Mks 3, 3A, 3B** and **4.**

Viscount 700D The Viscount had its origins in the Brabazon Committee Type IIB requirement of March 1945 for "a 24-seat aircraft, powered with four gas turbine engines driving airscrews for European and other short-to-medium-range services." The V.630 Viscount prototype, seating up to 36 passengers, made its first flight on July 16, 1948, but for BEA it was stretched into the V.700 with 1,400 s.h.p. RDa.3 Darts and seating up to 53 passengers; the prototype V.700 first flew on August 28, 1950. A month before, the V.630 prototype had been used by BEA on the world's first scheduled commercial passenger services with a turbine-powered aeroplane; the corporation introduced services with its production V.701s on April 19, 1953. The basic V.700D differs from the V.700 in having the more powerful RDa.6 Darts, more fuel and increased take-off weight.

BEA's V.701 Viscounts have been converted to a high-density version with 63 seats and airstairs. The Viscount 700's secondhand price is around £200,000-£250,000. New price in 1958 was about £400,000 ($1.1m); production ceased in 1959.

Flight references: July 15, 1955 (history and origins; development of North American versions), January 31, 1958 (a Viscount order book appeared in *Flight* for September 7, 1961, p. 403).

Powerplant: Four Rolls-Royce RDa.6 Dart 510 turboprops of 1,740 e.h.p. (1,600 s.h.p.) each driving 10ft Rotol propellers.

Dimensions: Span, 93ft 8½in; length, 81ft 10in; height, 36ft 9in; wing area, 963 sq ft.

Weights: Max take-off, 64,500lb; landing, 57,500lb; zero fuel, 50,168lb; capacity payload, 11,600lb; weight less fuel and payload, 38,358lb.

Payload accommodation: Cabin volume, 2,370 cu ft; baggage and freight volume 215 cu ft; cabin length 45ft; max width, 10ft; max height, 6ft 6in; usable floor area, 430 sq ft; dimensions of largest door, 63½ × 55in (elliptical); max seats, 63 at 34in pitch.

Fuel capacity: 2,206 Imp gal plus 110 Imp gal water-methanol.

Performance: Opt-cost cruising speed, 270kt (310 m.p.h.) at 20,000ft and 57,500lb; corres fuel consumption, 335 gal/hr; balanced field length at max take-off weight, sea level, ISA, 5,310ft; sea level, ISA + 15°C, 5,850ft; 5,000ft, ISA, 7,200ft; landing distance from 50ft (unfactored), 2,920ft; range A (max payload), 1,550 n.m. (1,780 st.m.); range B (max fuel), 1,740 n.m. (2,000 st.m.) with 10,400lb payload.

Design speeds: VNE, 260kt (300 m.p.h.) EAS; VNO, 258kt (296 m.p.h.) EAS; VSO, 88.5kt (101.5 m.p.h.) EAS.

Viscount 800, 810 Development of a stretched version of the Viscount had been started by BEA and Vickers before the V.701 had entered airline service, and on February 11, 1953, BEA ordered 12 V.801 Viscounts. This version, powered by four 1,690 e.h.p. RDa.5 Darts, was to have had a fuselage 13ft 3in longer than the V.701s. But the V.801 was abandoned because it was too large for traffic requirements as then foreseen, and it was replaced by the V.802.

Apart from more powerful Darts, the Viscount 810 differs from the 800 in having a structure strengthened to cater for a higher landing weight and a higher cruising speed. To date more than 70 V.810s have been sold to 14 operators, and production continues.

A grand total of 429 Viscounts of all versions has been sold to 54 operators—42 of whom are airlines—in 35 countries. A handful of executive Viscount 700s, some of which are operated in military markings, have been supplied to various foreign governments as VIP and personnel transports. References: *Flight*, February 22, 1957 (Viscount 802 description); February 28, 1958 (Viscount 810 description). The following figures apply to the Viscount 810:—

Powerplant: Four Rolls-Royce RDa.7/1 Dart 525 turboprops of 1,990 e.h.p. (1,800 s.h.p. plus 500lb thrust), driving 10ft Rotol propellers.

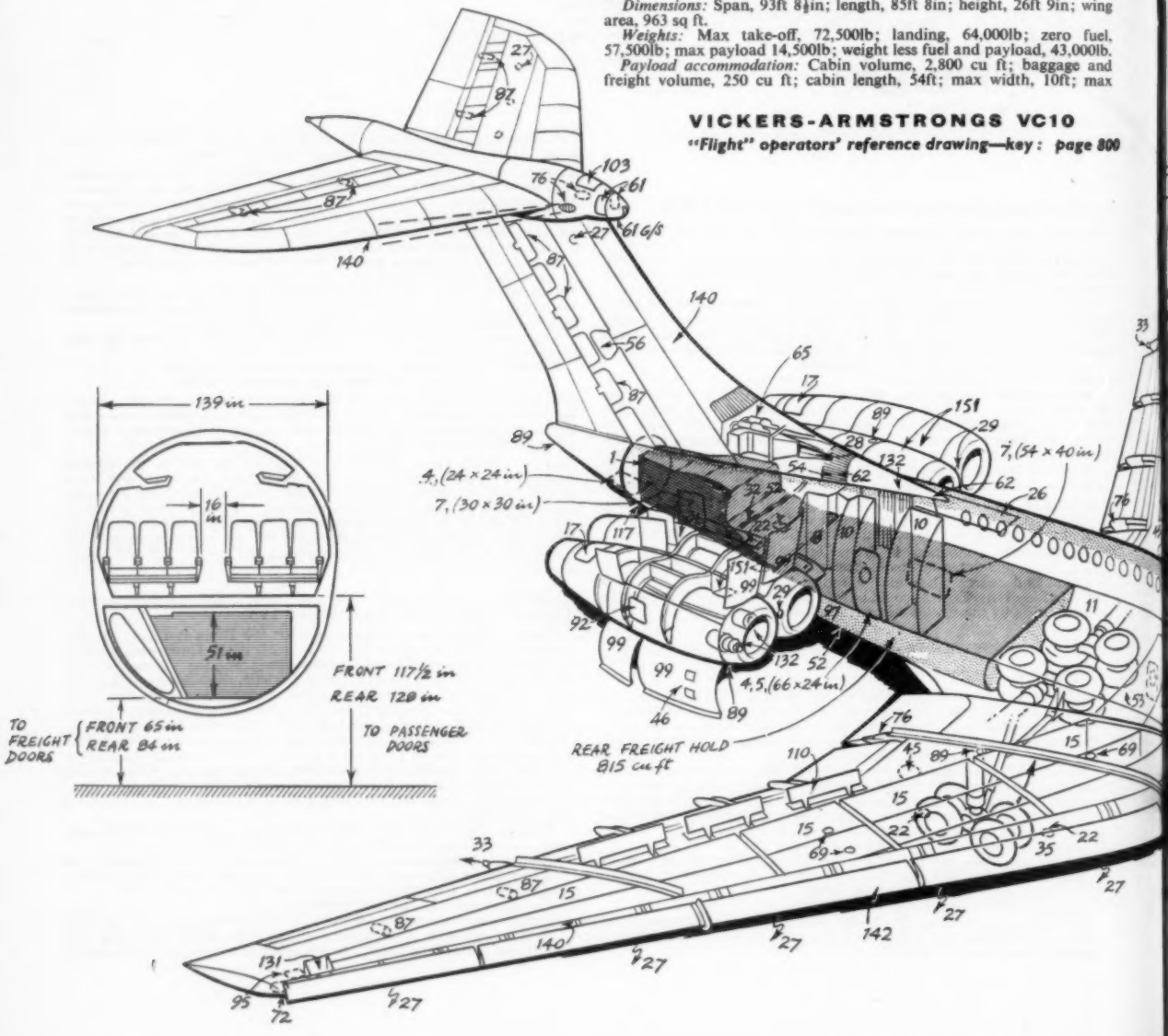
Dimensions: Span, 93ft 8½in; length, 85ft 8in; height, 26ft 9in; wing area, 963 sq ft.

Weights: Max take-off, 72,500lb; landing, 64,000lb; zero fuel, 57,500lb; max payload 14,500lb; weight less fuel and payload, 43,000lb.

Payload accommodation: Cabin volume, 2,800 cu ft; baggage and freight volume, 250 cu ft; cabin length, 54ft; max width, 10ft; max

VICKERS-ARMSTRONGS VC10

"Flight" operators' reference drawing—key: page 800



height, 6ft 6in; usable floor area, 520 sq ft; dimensions of largest door, 64in × 36 in; max seats, 70.

Fuel capacity: 1,900 Imp gal (2,280 US gal) plus 110 Imp gal (132 US gal) water-methanol.

Performance: Opt-cost cruise speed, 309kt (355 m.p.h.) at 18,000ft and 60,000lb; corres fuel consumption, 400 Imp gal/hr; balanced field length, sea level, ISA, 6,200ft; at sea level, ISA + 15°C, 6,650ft; at 5,000ft, ISA, 8,170ft; landing distance from 50ft (unfactored), 3,150ft; range A (max payload) 1,500 n.m. (1,725 st.m.); range B (max fuel) 1,530 n.m. (1,760 st.m.; corres payload, 14,300lb; range B with slipper tanks, 1,930 n.m. (2,220 st.m.).

Design speeds: VNE, 285kt (328 m.p.h.) EAS; VNO, 256kt (294 m.p.h.) EAS; VSO, 92.5kt (106 m.p.h.) EAS.

Basic price: £535,000 ($1.5m).

V.950 Vanguard The Vanguard was the culmination of two years' detailed discussion between BEA and Vickers and Rolls-Royce, in 1954 and 1955, for a Viscount replacement. The corporation drew up a 50-page specification early in 1955 and in October of that year placed an order for 20 aircraft at a price, with spares, of approximately £1m each. In January, 1957, after "one of the most exhaustive analyses ever undertaken," TCA placed an order for 20 aircraft and parts worth £23.9m. The airline announced its intention to buy three more on April 27, 1960.

The first Vanguard, G-AOYW, made its first flight on January 20, 1959. By the beginning of June 1960, when eight aircraft had flown nearly 1,400hr, the BEA Vanguard V.951 was ready for ARB type-certification with delivery of six to BEA scheduled for June-August. A fault in the Tyne compressor discovered by Rolls-Royce on the test bed, and the subsequent modifications, led to a revision of the programme. Following 250hr of intensive "engine-assurance" flying by V.951 G-APED during October and early November 1960, a certificate of airworthiness was awarded to the type in December 1960. The first revenue passengers were carried on the London-Paris route by BEA on December 17, 1960. Full BEA Vanguard schedules began on March 1, 1961, with a London-Paris service. TCA introduced their Vanguards into service on February 1, 1961.

BEA have six Type 951s with Rolls-Royce Tyne 506s, and with a maximum weight of 135,000lb. The remaining 14 are Type 953s with the same engines but with a higher maximum weight (141,000lb) and increased payload. TCA's 23 aircraft have Tyne 512s of 5,545 e.h.p.—560 e.h.p. more than the Tyne 506.

Flight references: January 9, 1959 (special issue); July 25, 1958, page 129. Production of the Vanguard will cease with delivery of the 43rd aircraft early in 1962.

The following data are for the V.952 Vanguard, this version being based on that for TCA:—

Powerplant: Four Rolls-Royce Tyne RTy.11 (Mk 512) turboprops of 5,545 e.h.p. each, driving de Havilland Hydromatic trapezoidal-blade 14ft 6in propellers.

Dimensions: Span, 118ft; length, 122ft 10½in; height, 34ft 11in; wing area, 1,529 sq ft.

Weights: Max take-off, 146,500lb; landing, 130,500lb; zero fuel, 122,500lb; capacity payload, 37,000lb; weight less fuel and payload, 85,500lb.

Payload accommodation: Cabin volume, 5,690 cu ft; baggage and freight volume, 1,360 cu ft; cabin length, 90ft; max width, 10ft 9in; max height, 6ft 10½in; max usable floor area, 893 sq ft; dimensions of largest door, 6ft × 3ft 5in (passenger door), 3ft 10in × 5ft 6in (freight); max seats, 139 at 34in pitch.

Fuel capacity: 5,100 Imp gal (6,125 US gal).

Performance: Opt-cost cruising speed at 20,000ft, 135,000lb, 358kt (412 m.p.h.); corres fuel consumption, 710 Imp gal/hr; field length, max take-off weight, sea level, ISA, 5,200ft; sea level, ISA + 15°C, 5,850ft; elev 5,000ft, ISA, 7,200ft; landing from 50ft, 3,970ft; range A (max payload), 1,590 n.m. (1,830 st.m.); range B (max (fuel), 2,720 n.m. (3,130 st.m.); corres payload, 20,500lb.

Operators' reference drawing: page 833

TCA's Vanguards are used on domestic and Caribbean routes

VC10 BOAC's intention to order this big new British jet transport—the biggest aircraft ever to be put into production in Britain—was announced in May 1957, and a contract was signed in January 1958. Originally, the order was for 35 VC10s with an option on a further 20. On June 23, 1960, a contract was signed for 10 Super VC10s with an option on a further 10. The Super VC10, as it was then envisaged, was a very large aircraft, stretched by some 27ft, and with maximum seating for 212 passengers, 60 more than in the standard VC10.

Towards the end of 1960 BOAC fundamentally revised their VC10 orders, asking Vickers to reduce the size of the Super VC10, and to make it available on the production line as the sixteenth aircraft, i.e., after production of only 15, instead of 35, standard VC10s.

By May 1961 these plans had been confirmed and the contract was revised to provide for delivery of 15 standard VC10s and 30 "less super" Super VC10s. According to BOAC's 1960-61 annual report, delivery of the 15 standard VC10s is due to start in November 1963, and to be completed in August 1964; delivery of 30 Supers is due to start in October 1964 and to be completed in October 1966. The effect of the design and contractual amendments to the Super VC10 programme in 1960 and 1961 is that BOAC will have in service sooner an advanced version of the VC10, and one that is not so large and (from the runway point of view) as inflexible as the original Super VC10. A proposed development of the standard VC10, with improved payload-range performance, may also be built for other customers.

It is expected that the first VC10 will be flying before the middle of 1962. Orders have been placed also by Ghana Airways (three standard VC10s) (British United four standard VC10s) and by the RAF (five standard VC10s).

Price of the standard VC10 is quoted as £2.2m fully equipped except for seats; equivalent price of the Super is £2.5m.

Swing-nose freighter developments of VC10, and also of the Super VC10, are contemplated; design studies have been made, though no figures are at present available. Design work on a side-loaded VC10 freighter is in hand.

Powerplant: Four Rolls Royce Conway RCo42/1 of 21,000lb thrust.

Dimensions: Span, 140ft 2in; length, 158ft 8in; height empty, 39ft 6in; wing area, 2,800 sq ft; sweepback at ¼ chord, 32.5°.

Weights: Max take-off, 299,000lb; max landing, 199,000lb; zero fuel, 178,000lb; weight limited payload, 35,500lb; weight less fuel, crew and payload, 141,000lb.

Payload accommodation: Cabin volume (less flight deck), 6,750 cu ft; baggage and freight volume, 1,350 cu ft; cabin accommodational length, 92ft 4in; max internal width, 11ft 6in; max height, 7ft 6in; max usable floor area (less flight deck), 1,000 sq ft; dimensions of largest door, 72in × 34in; max number of seats, 135 at 34in pitch.

Fuel capacity: 17,940 Imp gal.

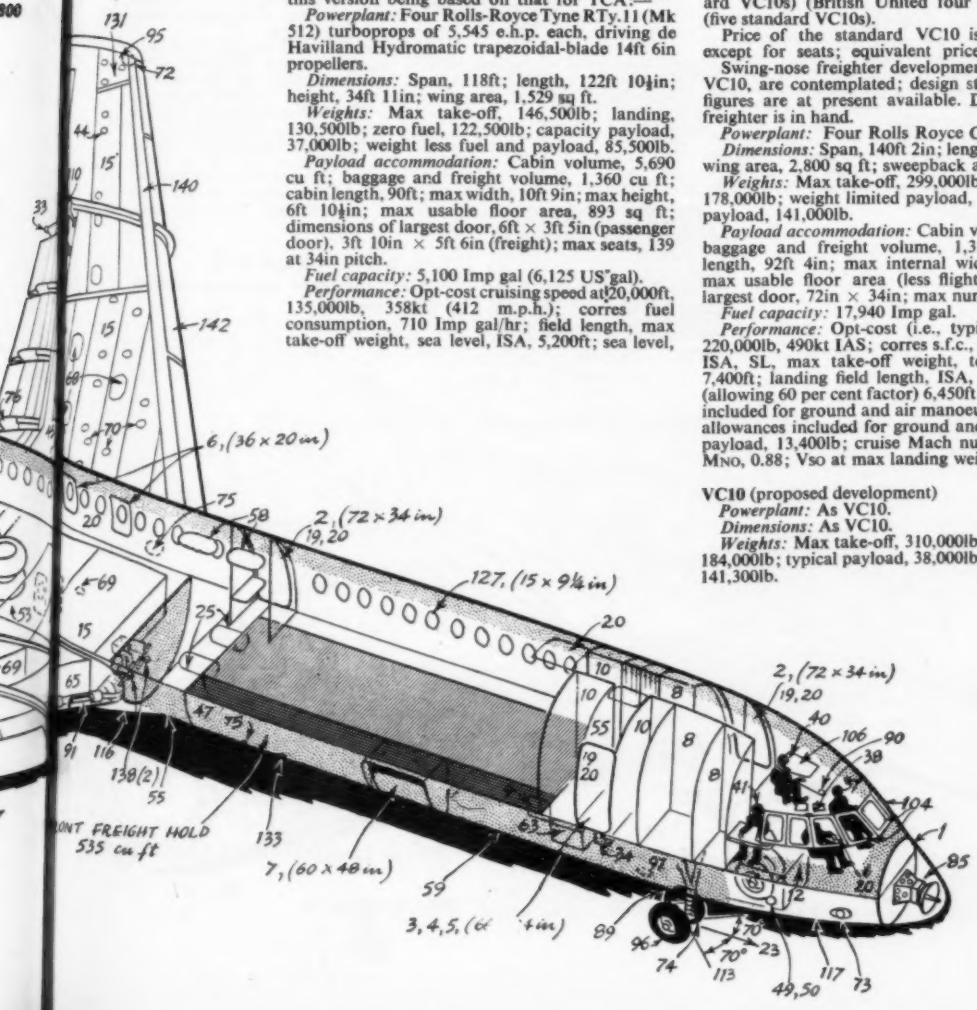
Performance: Opt-cost (i.e., typical) cruising speed at 36,000ft and 220,000lb, 490kt IAS; corres s.f.c., 0.0375 n.m./lb; take-off field length, ISA, SL, max take-off weight, to 35ft (1.18 × 4-engine distance), 7,400ft; landing field length, ISA, SL, max landing weight from 50ft (allowing 60 per cent factor) 6,450ft; range A (max payload), allowances included for ground and air manoeuvre, 4,550 n.m.; range B (max fuel), allowances included for ground and air manoeuvre, 5,620 n.m.; corres payload, 13,400lb; cruise Mach number at 36,000ft, 0.88; MNE, 0.90; MNO, 0.88; VSO at max landing weight, 94kt EAS.

VC10 (proposed development)

Powerplant: As VC10.

Dimensions: As VC10.

Weights: Max take-off, 310,000lb; max landing, 206,000lb; zero fuel, 184,000lb; typical payload, 38,000lb; weight less fuel, crew and payload, 141,300lb.



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Payload accommodation: Cabin volume (less flight deck), 6,750 cu ft; baggage and freight volume, 1,350 cu ft; cabin accommodational length, 92ft 4in; max internal width, 11ft 6in; max height, 7ft 6in; dimensions of largest door, 72in + 34in; max seats, 135 at 34in pitch.

Fuel capacity: 17,940 Imp gal.

Performance: Opt-cost (i.e., typical) cruising speed at 36,000ft and 220,000lb, 490kt IAS; corres s.f.c., 0.0375 n.m./lb; take-off field length, ISA, SL, max take-off weight to 35ft (1.18 × 4 engine distance), 8,100ft; landing field length, ISA, SL, max landing weight from 50ft (allowing 60 per cent factor), 6,700ft; range A (max payload), allowances included for air and ground manoeuvre, 4,630 n.m.; range B (max fuel), allowances included for air and ground manoeuvre, 5,460 n.m.; corres payload, 24,100lb; cruise Mach number at 36,000ft, 0.88; MNE 0.90; MNO, 0.88; VSO at max landing weight, 96kt EAS.

Super VC10

Powerplant: Four Rolls-Royce Conway RCo.42/3 of 22,500lb thrust.

Dimensions: Span, 140ft 2in; length, 171ft 8 in; height empty, 39ft 6in; wing area, 2,800 sq ft; sweepback at chord ¼, 32.5°.

Weights: Max take-off, 322,000lb; max landing, 225,000lb; zero fuel, 200,000lb; typical payload, 45,000lb; weight less fuel, crew and payload, 150,450lb.

Payload accommodation: Cabin volume (less flight deck), 7,600 cu ft; baggage and freight volume, 1,950 cu ft; cabin accommodational length, 105ft; max internal width, 11ft 6in; max height, 7ft 6in; max usable floor area (less flight deck), 1,130 sq ft; dimensions of largest door, 72in × 34in; max number of seats, 163 at 33in pitch.

Fuel capacity: 19,315 Imp gal.

Performance: Opt-cost (i.e., typical) cruising speed at 36,000ft and 230,000lb, 490kt IAS; corres s.f.c., 0.0378 n.m./lb; take-off field length, ISA, SL, max take-off weight to 35ft (1.18 × 4 × engine distance), 8,200ft; landing field length, ISA, SL, max landing weight from 50ft (allowing 60 per cent factor), 7,300ft; range A (max payload), allowances included for air and ground manoeuvre, 4,470 n.m.; range B (max fuel), allowances included for air and ground manoeuvre, 6,060 n.m.; corres payload, 18,230lb; cruise Mach number at 36,000 ft.[0.88; MNE, 0.90; MNO, 0.88; VSO at max landing weight, 100kt EAS.

VC11 This project for a medium-haul scaled-down version of the VC10 was dropped in May 1961 in favour of the BAC One-Eleven.

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AW.650 Argosy The Argosy is aimed at the big potential air freight business. It is the only pressurized turboprop freighter (four Darts) designed from the outset for civil use, and it is also the only freighter with a swing nose and a swinging aft end to permit rapid loading.

The first contract for Argosies was signed by the American all-cargo line, Riddle Airlines, for seven Series 100 Argosies. After delivery of the first aircraft on December 8, 1960, first revenue flight on "Logair" work—first such commercial flight by a pressurized turboprop all-freighter—was on January 15, 1961. BEA has also ordered three of this version; delivery is current as this issue goes to press, and first scheduled service, between London and Milan, is due on November 26. (Details of BEA's Argosy plans: *Flight*, October 26, 1961, page 669.) First flight of the Argosy was on January 8, 1959, at Bitteswell. Certification testing was completed in September 1960, by when it had been confirmed that financial assistance would be made available by the Government for development. A second version of the civil Argosy, the Series 200, is now in production, with a box-spar, integral-tank wing and other improvements.

An order for 56 AW.660s (the military version) for RAF Transport Command will be of considerable value to the civil programme.

The following data are common to both the Series 100 and Series 200 Argosy:—

Powerplant: Four Rolls-Royce Dart 526 RDa.7/2 of 2,100 e.h.p. each driving Rotol Type R.186/4-30 11ft 6in propellers.

Dimensions: Span, 115ft; length, 86ft 9in; height empty, 27ft; wing area, 1,458 sq ft.

Payload accommodation: Cabin volume, 3,680 cu ft; passengers' baggage volume, 182 cu ft; cabin length, 46ft 10in; max width, 11ft 8in; max height, 8ft 9in; max usable floor area, 426 sq ft; dimensions of largest doors, 6ft 8in × 8ft 8in; max seats, 84 at 32in pitch.

Water-methanol capacity: 137 Imp gal (164 US gal).

Series 100

Weights: Max take-off, 88,000lb; max landing, 84,000lb; zero fuel, 77,500lb; capacity payload, 28,000lb; weight less fuel and payload, 48,500lb.

Fuel capacity: 3,300 Imp gal.

Performance: Typical cruising speed, 240kt at 18,000ft and 75,000lb; corres fuel consumption, 0.076 n.m./lb; take-off field length, SL, ISA, 5,000ft; landing field length, 5,500ft from 50ft fully factored; range A (max payload), 780 n.m.; range B (max fuel), 2,370 n.m.; corres payload, 13,100lb for 2,070 n.m.; VNE, 270kt IAS; VNO, 235kt IAS; VSO, 89kt IAS at 84,000lb.

Series 200

Weights: Max take-off, 90,000lb; landing, 84,000lb; zero fuel, 80,000lb; capacity payload, 31,000lb; weight less fuel and payload, 49,000lb.

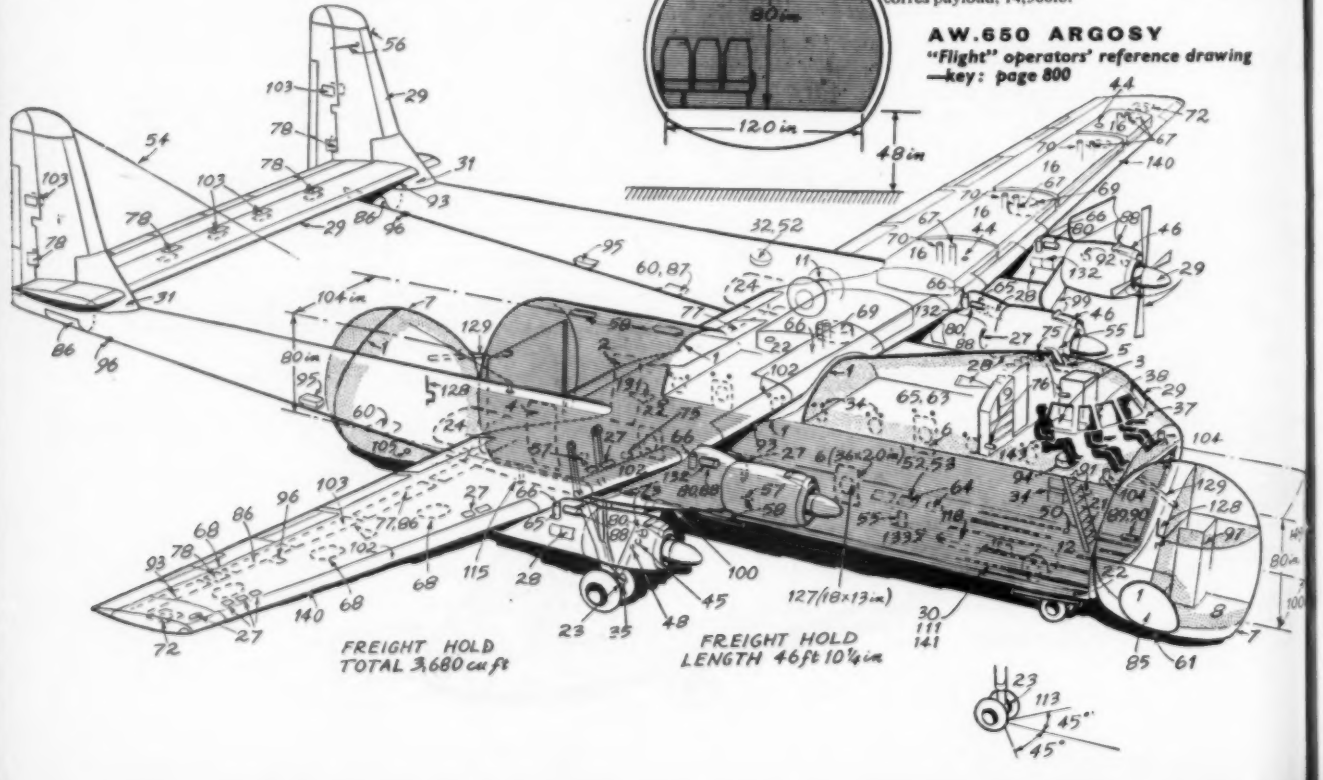
Fuel capacity: 3,400 Imp gal (4,080 US gal).

Performance: Typical cruising speed, 240kt at 18,000ft and 75,000lb; corres fuel consumption, 0.076 n.m./lb; balanced field length, max take-off weight, SL, ISA, 5,300ft; at SL, ISA + 15°C, 5,560ft; at 5,000ft, ISA, 7,000ft; landing distance from 50ft, 5,500ft; range A (max payload), 650 n.m.; range B (max fuel), 2,400 n.m.; VNE, 270kt IAS; VNO, 235kt IAS; VSO, 89kt IAS at 84,000lb.

AW.670 Air Ferry This project is a variant of the Argosy intended for car ferry operations for short-haul, very high density (132 seats) passenger operations. A similar aircraft, it is designated AW.671 Airbus. It has a bigger non-pressurized fuselage and engines of increased power. Data which differ from the Argosy are as follows:—

Payload accommodation: Cabin volume, 1,058 cu ft (upper deck); cabin volume, 6,500 cu ft (lower deck); baggage volume, 250 cu ft; cabin length, 58ft; max width, 15ft; max height, 8ft 6in; max usable floor area, 870 sq ft; dimensions of largest door, 8ft 6in × 15ft; max seats, 132.

Performance: Typical cruising speed, 264kt at 10,000ft and 80,000lb; corres fuel consumption, 0.057[n.m./lb; balanced field length,'max take-off weight, SL, ISA, 5,100ft; at SL, ISA + 15°C, 5,450 ft; at 5,000ft, ISA, 6,350ft; landing distance from 50ft, 3,560ft; range A (max payload), 630 n.m.; range B (max fuel), 1,410 n.m.; corres payload, 14,500lb.



AW.650 ARGOSY
"Flight" operators' reference drawing
—key: page 800

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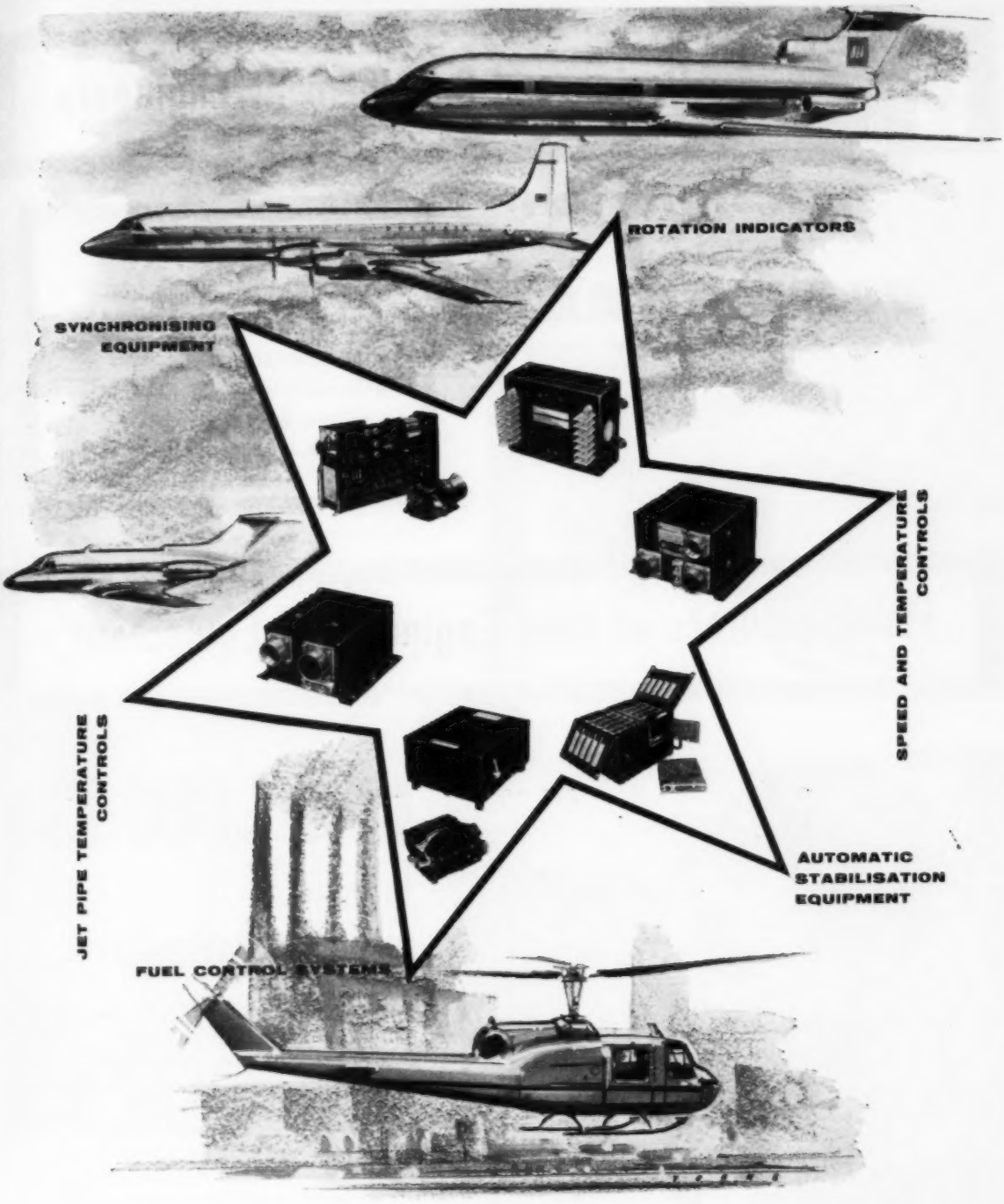

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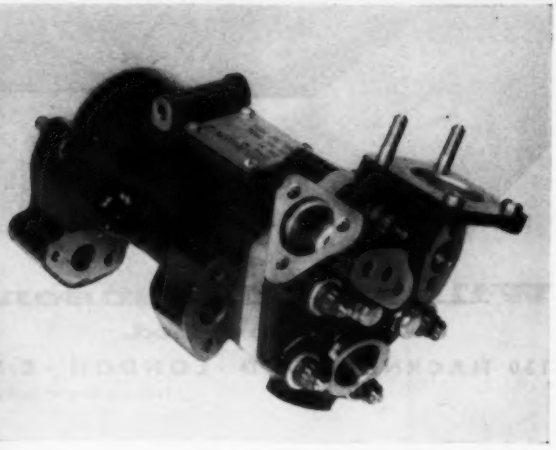

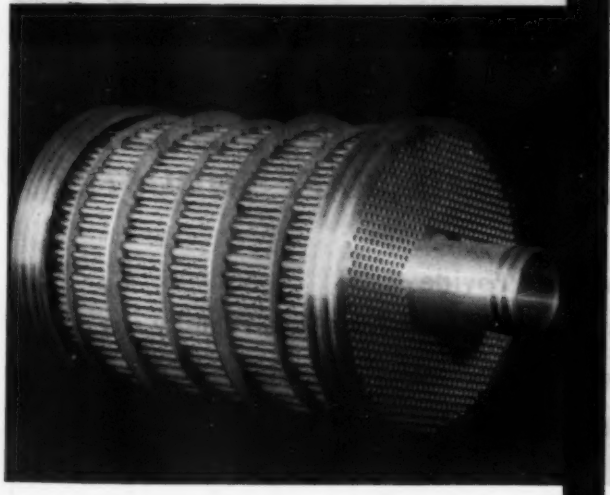

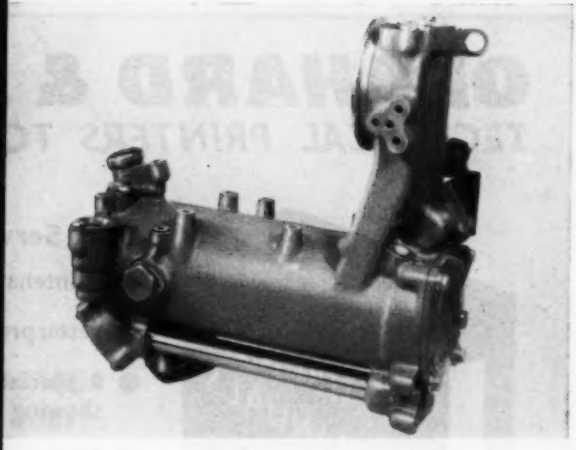

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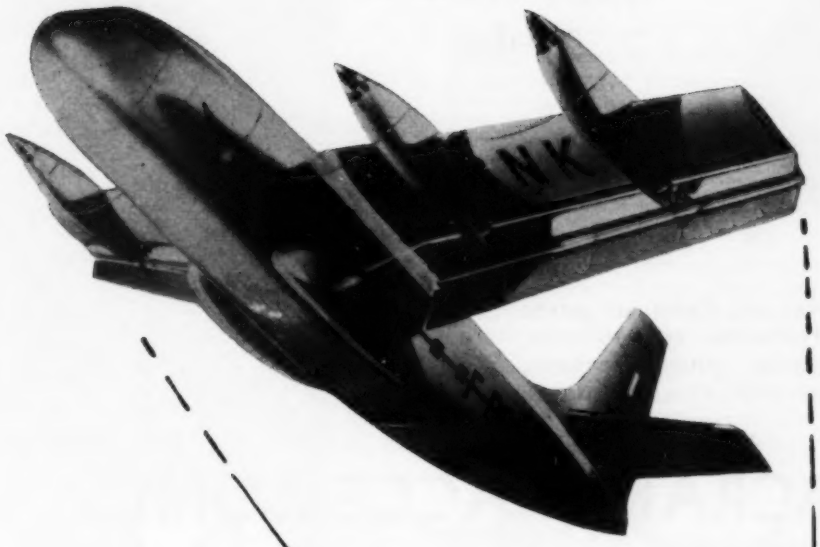

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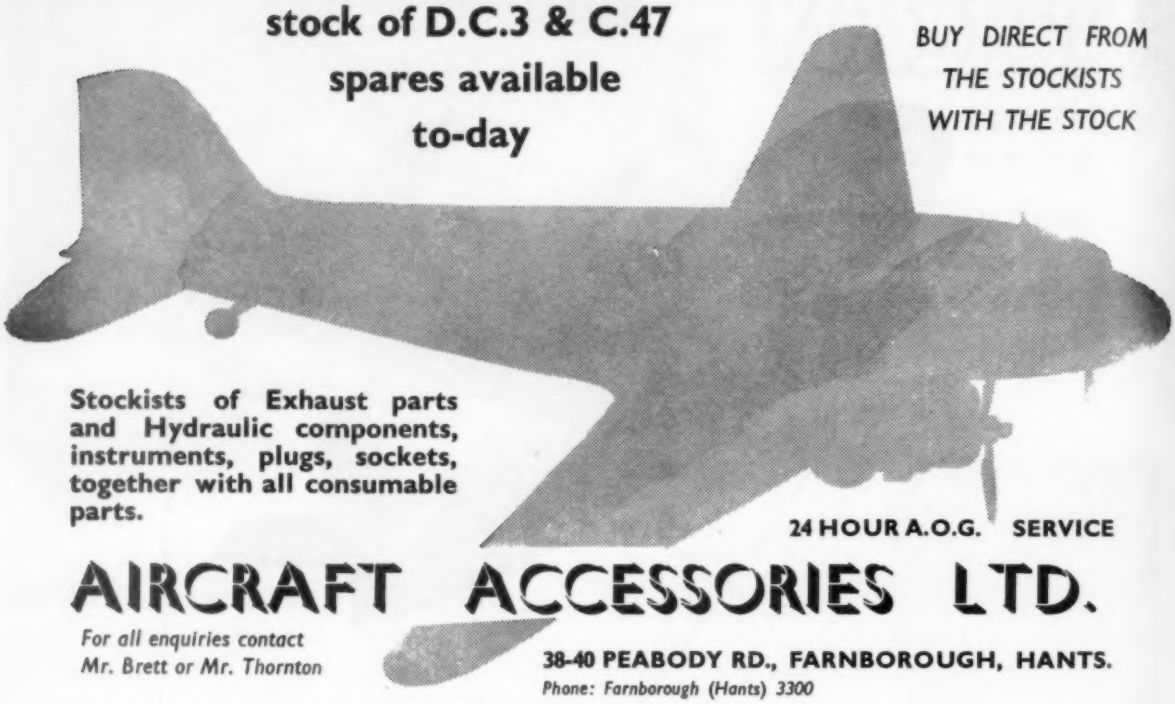

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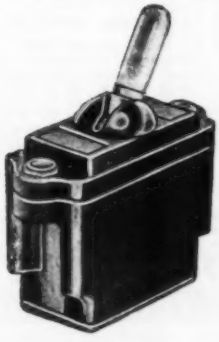

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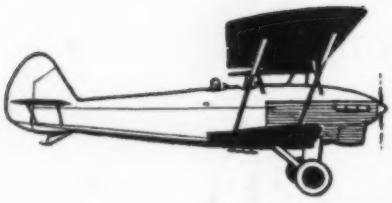

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